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Demystifying Major Automated Information System Programs

U.S. NAVY

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DODCAS Presentation

31 Jan 2002

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Purpose

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- Understanding of Major Automated Information Systems (MAIS)
- Clinger-Cohen Act influences on MAIS acquisition
- Challenges in assessing the incorporation of new technology
- Cost estimating implications of new technology

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Joint Vision 2020

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Operations within the information domain will become as important as those conducted in the domains of sea, land, air and space. …

Information, information processing, and communications networks are at the core of every military activity.

Interoperability is a mandate for the joint force of 2020 especially in terms of communications, common logistics items, and information sharing. … These features are not only vital to the joint force, but to multinational and interagency operations as well.

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Outline

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- **MAIS Programs**
- **Clinger-Cohen Requirement**
  - Business Process Reengineering
  - Alternative of Analysis
  - Economic Analysis
  - Performance Measures
  - Information Security
- **Other AIS Challenges**
  - IT Cycle Time Reductions
  - Enterprise Resource Planning (ERP) Systems
- **Cost Estimating Implications**
  - Current Processes
  - ERPs
- **Summary**

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MAIS Programs

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Major Automated Information System (MAIS) – Is an acquisition program that acquires Information Technology, except IT that involves equipment that is an integral part of a weapon system or is a tactical communication system

- Characterization of a MAIS program is determined by cost threshold (FY00$)
  - At least $32M program cost in any one year, or
  - At least $126M total program cost, or
  - At least $378M total life cycle cost

Acquisition Program Categories

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Milestone Decision Authority

- **ACAT I -- Major Defense Acquisition Programs (MDAP)**
  - ACAT ID — USD (A&T)
  - ACAT IC — DoD Component Head
- **ACAT IA -- Major Automated Information Systems (MAIS)**
  - ACAT IAM — OSD Chief Information Officer
  - ACAT IAC — DoD Component Head

- **ACAT II – Major Systems**
  DoD Component Head
- **ACAT III – All Other Acquisition Programs**
  Designated by DoD Component Head

MAIS Programs

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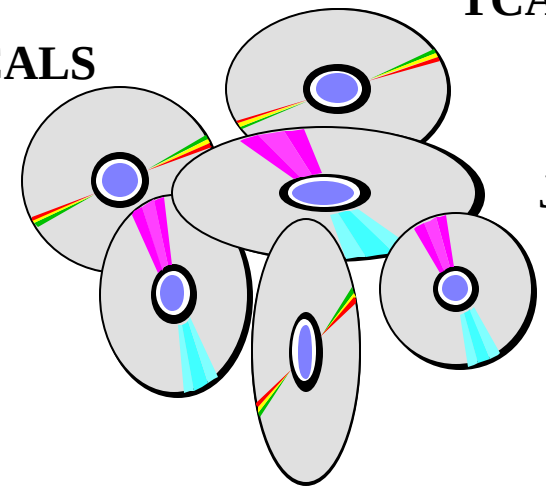
TCAIMS II

JCALS



JEDMICS

TRAC²ES

NSIPS

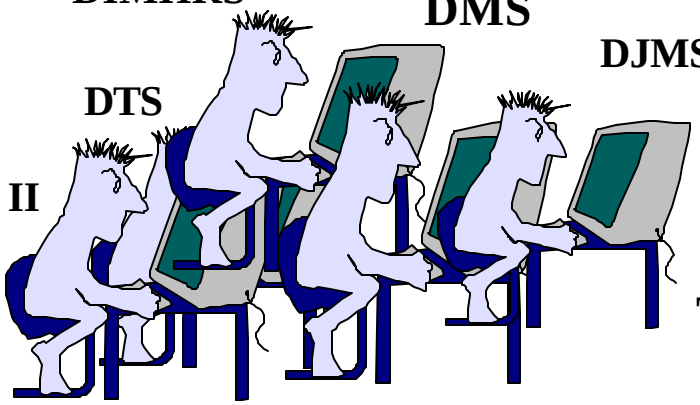
SPS

DIMHRS

DMS

DJMS

DTS



CHCS II

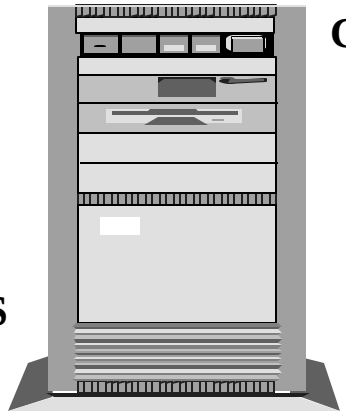
DCPDS

TMIP

ILS-S

GTN-21

IMDS



NTCSS

GCSS

FY00-02 DoD IT Investments By Agency

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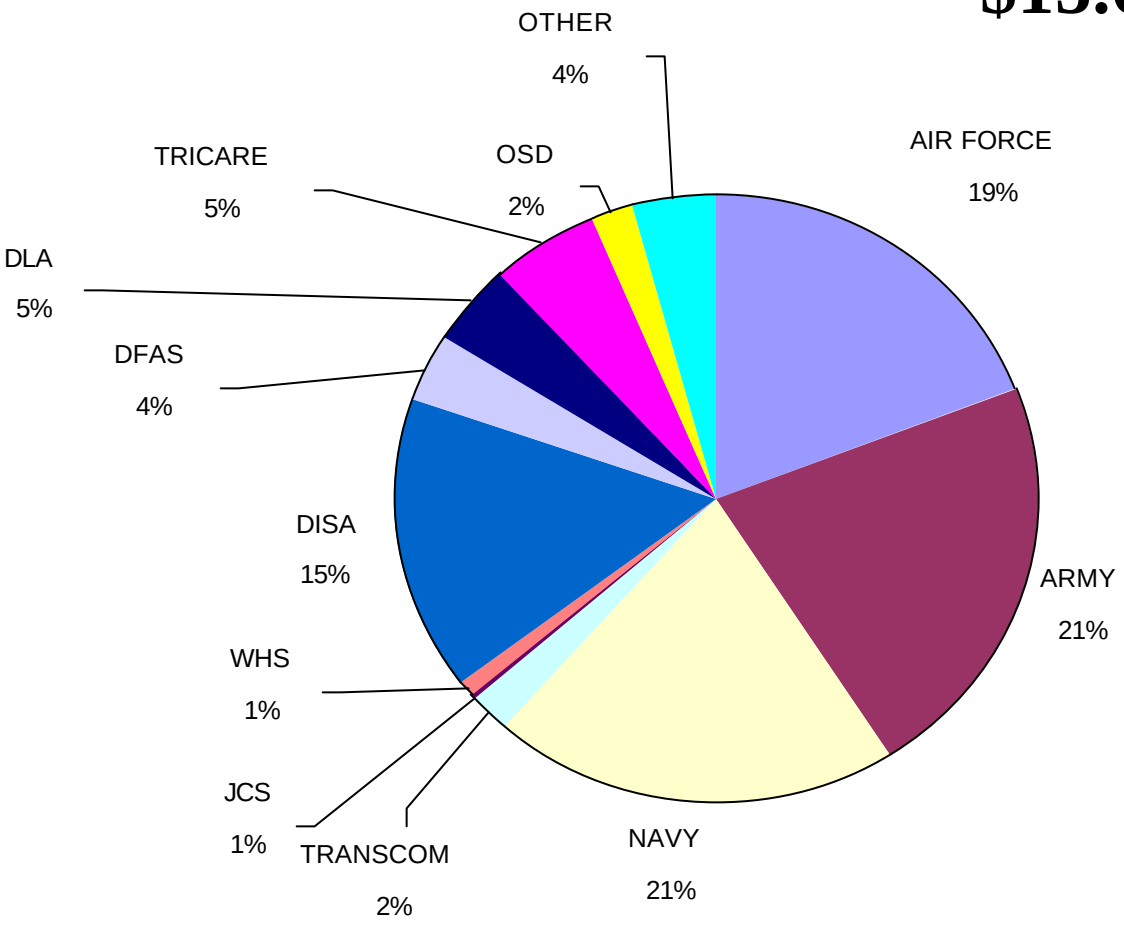
$15.6B/Yr Average



http://www.c3i.osd.mil/org/pe/rmd/infotech/

FY 00-02 DoD IT Investments By Function

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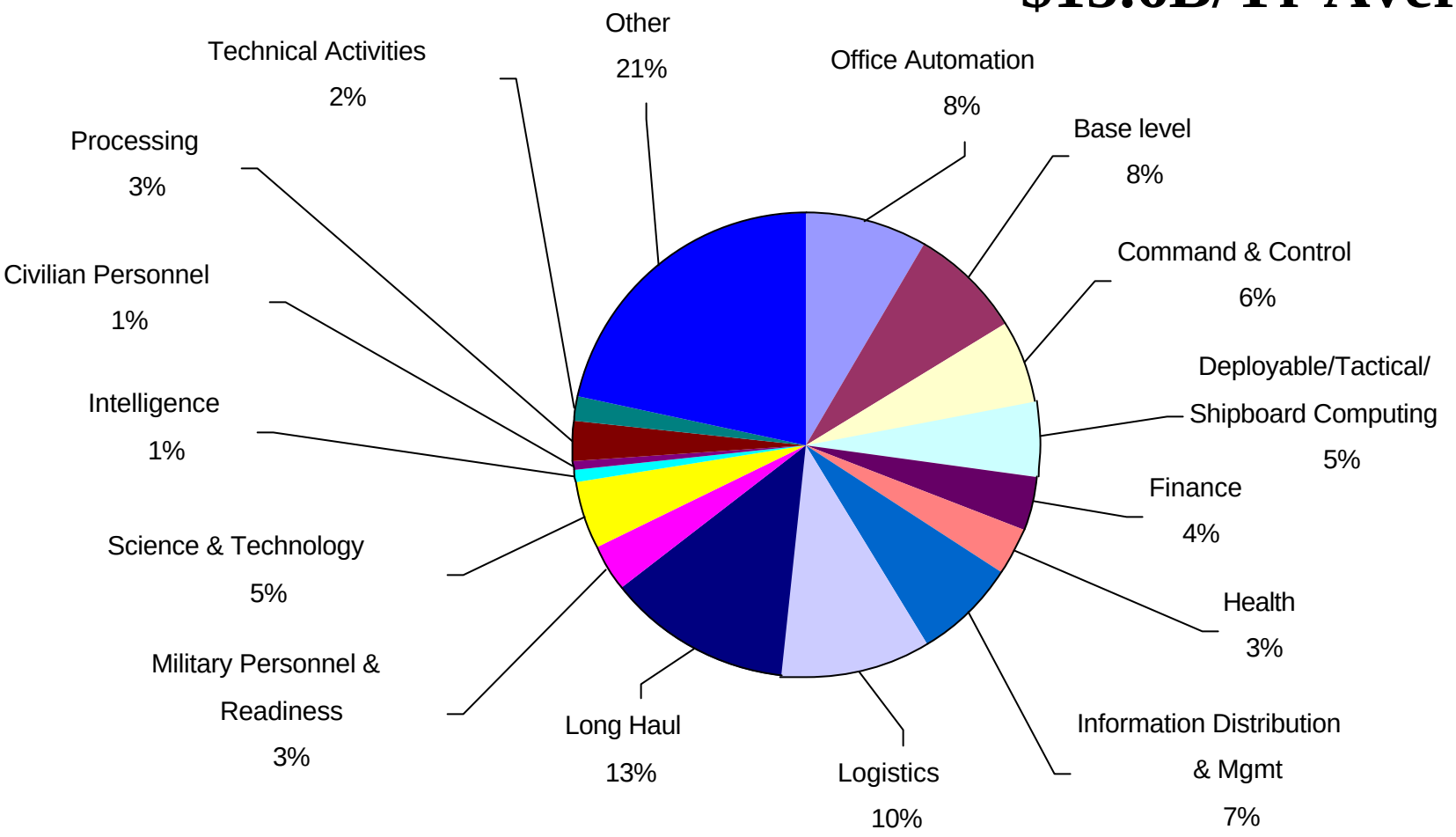
$15.6B/Yr Average



http://www.c3i.osd.mil/org/pe/rmd/infotech/

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IT Expenditures

- Tech spending projected to jump 65 percent in five years
- Government Total IT budget would rise
  - $36.4 billion in fiscal 2001
  - $60.3 billion in fiscal 2006
- Distinct impact on government IT spending as a result of the terrorist attacks on Sept. 11
  - Security is the priority from Web sites and online data to protecting the infrastructure that allows communication to back up data on remote servers

Source: GovExec Oct 17, 2001

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  - Economic Analysis
  - Performance Measures
  - Information Security
- **Other AIS Challenges**
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- **Cost Estimating Implications**
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"Computer Chaos"

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- Insufficient attention to 1) the way business processes are conducted, and 2) opportunities to improve these processes before investing in the IT that supports them;
- Investments in new systems for which Agencies had not adequately planned, and which did not work as intended and did little to improve mission performance;
- Implementation of ineffective information systems resulting in waste, fraud, and abuse; and
- Outdated approaches to buying IT that do not adequately take in account the competitive and fast pace nature of the IT industry.

Clinger-Cohen Act (CCA) of 1996

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- Redefines Information Technology Acquisitions
  - Require more emphasis on upfront evaluation, business process reengineering, life-cycle metrics
- Identifies new responsibilities for Director, OMB with respect to IT
  - OMB can withhold budget until satisfied that program planning is complete
- Identifies new responsibilities for heads of Executive Agencies and IT Acquisition
- Establishes Agency CIOs and duties

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CCA Mandates

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- Connect Business Process Owner and IT
- Achieve wise IT investments
  - Support core mission functions and redesigned or improved work (business) *process*
  - Ensure consistency with Agency *architecture*
  - Reflect *portfolio* (FoS) management approach
  - Maximize *interoperability*

Clinger Cohen Act (CCA) Certification/Confirmation

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- All ACAT IAM and IAC programs must obtain a *Certification* Report of Compliance with CCA.
- All other mission critical or mission essential IT programs must obtain *Confirmation* of Compliance by showing conformity to the CCA.
  - ASD (C3I), USD AT&L and the Services have drafted the CCA Compliance Table for inclusion in DoD 5000
- All other programs (ACAT II & III) programs must *Comply* with the CCA.

Clinger Cohen Act (CCA) Requirements

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Mission-Critical and Mission-Essential Information Systems As required by Sec. 8102(b) of the DoD Appropriations Act, 2001 (Pub. L. 106-398, Section 811):	NSS MDAP (MC)	NSS (non-MDAP) (MC or ME)	AIS (MC or ME)	MAIS (ME)	IT System (non-program) (ME)	NSS (lower than ACAT I or IA)	AIS (lower than ACAT I or IA)	IT System (non-programs)	DODI 5000.2, Change 1 Sections
Comply with CCA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	4.7.3.2.3.2 thru 4.7.3.2.3.2.4 and 4.7.3.3.3.2 thru 4.7.3.3.3.2.2
Confirm CCA Compliance to MDA	Yes	Yes	Yes	Yes	Yes	No	No	No	4.7.3.2.3.2 thru 4.7.3.2.3.2.4
Certify CCA Compliance to DOD CIO	No	No	No	Yes	No	No	No	No	4.7.3.2.3.2 thru 4.7.3.2.3.2.4
Register System with DOD CIO	Yes	Yes	Yes	Yes	Yes	No	No	No	4.7.3.2.3.2.1.11
No contracts awarded until: 1) System is registered with DOD CIO 2) DOD CIO determines information assurance strategy is appropriate 3) System being developed IAW CCA	Yes	Yes	Yes	Yes	Yes	No	No	No	4.7.3.1.5 and 4.7.3.1.5.1

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Clinger Cohen Certification

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- **Business Process Re-engineering**
- **Analysis of Alternatives**
- **Economic Analysis with ROI**
  - Economic Analysis has been conducted that includes a calculation for Return on Investment
- **Performance Measures**
  - Mission-related outcome-based performance measures have been established
  - Measurable performance metrics have been established to track progress in achieving predetermined goals
- **Information Security Measures**
  - Program has information assurance strategy – C4ISP

BPR and AoA

Three Pesky Questions from CCA:

1) Should the Agency be doing the function at all? Can someone else do it better? Core Mission?

2) If private sector should do it, should it be done under contract or should the government component be privatized? Who performs?

3) Is it organized and being done in the best way possible? A competitive advantage with efficient financial systems will hedge financial management from A-76 threats/ privatization. Re-engineered business process?

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Business Process Re-engineering

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- Identify the governance process through which the programs executive leadership manages change.
- How has the program mission been aligned with strategic goals?
- Have the gaps been assessed between the current performance and functional proponent/user needs?
- Can the process be accomplished more efficiently by other federal organizations?

http://www.bcinow.com/demo/clinger-cohen/Certification

Analysis Of Alternatives

- Develop and update BCA to support core functional requirements identified through the BPR process and needed to meet and evaluate mission needs.
- Does the proposed investment in IT support core mission processes and functions that need to be performed by the Government?
- Does the investment need to be undertaken by DoD because no alternative private sector or Government sources can better support the function?
- Does the investment support work processes that have been simplified or otherwise redesigned to reduce costs improve effectiveness and make maximum use of COTS technology?

http://www.bcinow.com/demo/clinger-cohen/Certification

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EADP / CARD

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- **Economic Analysis Development Plan (EADP)**
  - Purpose – Document the analytical approach and methodology and responsibilities for preparing cost and benefits estimates
  - Responsibilities – Tailor to the service process
  - WBS – Tailored appropriately for this program, but mapped into the EA guide
  - CIPT Schedule – Use a table
  - Include a snap-shot of the budget
- **Cost Analysis Requirements Document (CARD)**
  - System Description
  - System Operational Concept
  - System Quantity and Manpower Requirements
  - Milestone Schedule
  - Acquisition Plan
  - Development Plan

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EA General Guidelines

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- **Status Quo (SQ) Alternative** – SQ must be estimated (LCCE) and considered as the economic baseline
- **Preferred Alternative (PA)** – The IT investment alternative recommended by the program must be estimated (LCCE) and compared to SQ alternative
- **IT Program Benefit Estimate** – A benefit is any cost reduction avoidance or savings that will result if PA is implemented vice SQ Need to be phased by year over the entire life of the PA
- **Constant Base Year Dollars** – IT life cycle costs and program benefits will be estimated in constant base year dollars
- **Present Value of Costs and Benefits** – Using OMB Circular A-11 discount factor
- **Sunk Costs** – Value of all resources expended or irretrievably committed. Sunk costs are excluded from the EA/ROI calculation.

Certification should commence at least 3 months before Milestone

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AIS Guide

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- DoD AIS Economic Analysis Guide, Draft May 1995, OSD PA&E
  - 1.0 – Investment
  - 2.0 – Operations & Support
  - 3.0 -- Status Quo Phase Out
- Guide addresses the Benefits Analysis
  - A benefit is any cost reduction avoidance or savings that will result if PA is implemented vice SQ
- Guide addresses the ROI calculation

Return on Investment

ROI = Benefits / Investment

ROI is:

- the ratio of the present values of the additional cost to the Government to implement the PA in lieu of the SQ
- the cost of performing the mission or accomplishing the business functions impacted by the PA in lieu of the SQ

$$\frac{\text{Cost to do Mission}_{PA} - \text{Cost to do Mission}_{SQ}}{(\text{Cost to Implement}_{PA} + \text{SQ phase-out}) - \text{Cost to Maintain}_{SQ}}$$

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ROI Example

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	Investment ($M)		Benefits ($M)		O&S ($M)	
	PA	SQ & phase-out	PA	SQ	PA	SQ
FY02	24.7	24.0				
FY03	37.9	23.3				
FY04	45.7	25.0				
FY05	35.0	31.7				
FY06	38.0	19.5				
FY07 Pre FOC	25.6	19.4				
FY07 Post FOC			49.0	0	9.7	8.1
FY08			102.3	0	11.2	19.4
FY09			111.3	0	20.9	27.6
FY10			255.8	0	10.3	17.2
FY11			101.7	0	9.9	17.1
FY12			99.5	0	9.5	18.5
FY13			96.2	0	21.2	26.3
FY14			90.7	0	9.6	15.2
FY15			89.8	0	9.3	15.1
FY16			216.0	0	8.5	16.3
FY17			98.3	0	8.5	12.5
Total	206.9	142.9	1,310.6	0	128.6	193.3

PA Net Investment
PA Investment = 206.9

PA Benefits
1,310.6

PA O&S Delta
PA - SQ =128.6-193.3 = -64.

ROI = Net Benefits/Investment

Net Benefits = PA Benefits + O&S Delta	1,375.3
Net Investment =	206.9
ROI =	665%

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Return on Investment Concerns

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Methological Questions

- Does the S.Q. definition evolve as increments are deployed?
  - If so, what ROI do you present in CCA certification packet: Total program or Incremental
  - If initial increment bears brunt of non-recurring cost, what does ROI for follow-on increments really tell us?
- If the SQ is investing in the program during PA development how do you calculate ROI?
- If in a Joint Service program the PA will not meet one services' needs and legacy (SQ) program continues, what is the ROI implication?

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Sample Benefit

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Benefit Element Name:	Asset Release/Reallocation
Definition:	Early visibility of Patient Movement Requests (PMRs) assists in flow of transportation assets and allocation of available resources. Early visibility results in accurate determination of AE demand that can be consistently balanced against the need for force deployment
Peacetime/Contingency:	Contingency
IOC/FOC:	IOC
Dollar Type:	Constant Year 2001
Total Benefit Estimate $:	$3,708K
% of Quantifiable Benefits	1.90%
Benefit Data Expression:	A * B * C * D
Explanation of Benefit Data Expression:	Estimated cost savings associated with a reduction in medical flights is made possible through efficient flow of transportation assets with TRAC^{2}ES due to ability to accurately determine AE demand early.
Variables Defined:	A = Number of C-9 annual flying hours = 5,250
	B = Cost per C-9 flying hour = $8,828
	C = Percentage reduction in C-9 flights = 4%
	D = Number of contingencies = 2
Methodology:	Expert Opinion
Source of Data:	A = AFTOC data for FY00
	B = AFTOC data for FY00
	C = Regulate and Evacuate Patients Functional Economic Analysis Workshop, dated 13 April 1993 – 14 May 1993, verified by User Community, Nov 2000 and Feb 2001
	D = USTRANSCOM, 1998

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Performance Measures Benefits Analysis

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- **Types of benefits:**
  - **Quantifiable Cost Savings** – directly tied to a budget line
  - **Cost Avoidance** – not directly traceable to a budget line
    - Productivity Savings reflected
  - **Non-monetary Operational benefits** – not directly traceable to a budget line
    - Customer satisfaction
    - Supplier effectiveness
    - Timeliness
    - Accuracy

Requires Functional Support

Must be supported by a performance measurement plan

Demonstrated during Post-Implementation Reviews (PIRs)

Not included in ROI calc

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Information Security

- Identify the system's security feature, practices, procedures and architecture.
- Describe how the system architecture is consistent with DoD policies and standards
  - Evidence of compliance: C4ISP
    - Architectural Framework identified in C4ISR
    - Draft DoD GIG CRD contains checklist for compliance but does not address architectures or standards
- How restoration, recovery and information assurance are built into the system.

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Other AIS Challenges

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Reduced cycle time

ERPs

CERs

Cost Models

- **Software Cost Estimating**
- **Investment Cost Estimating**

Factors

Etc..

Faster Delivery of IT

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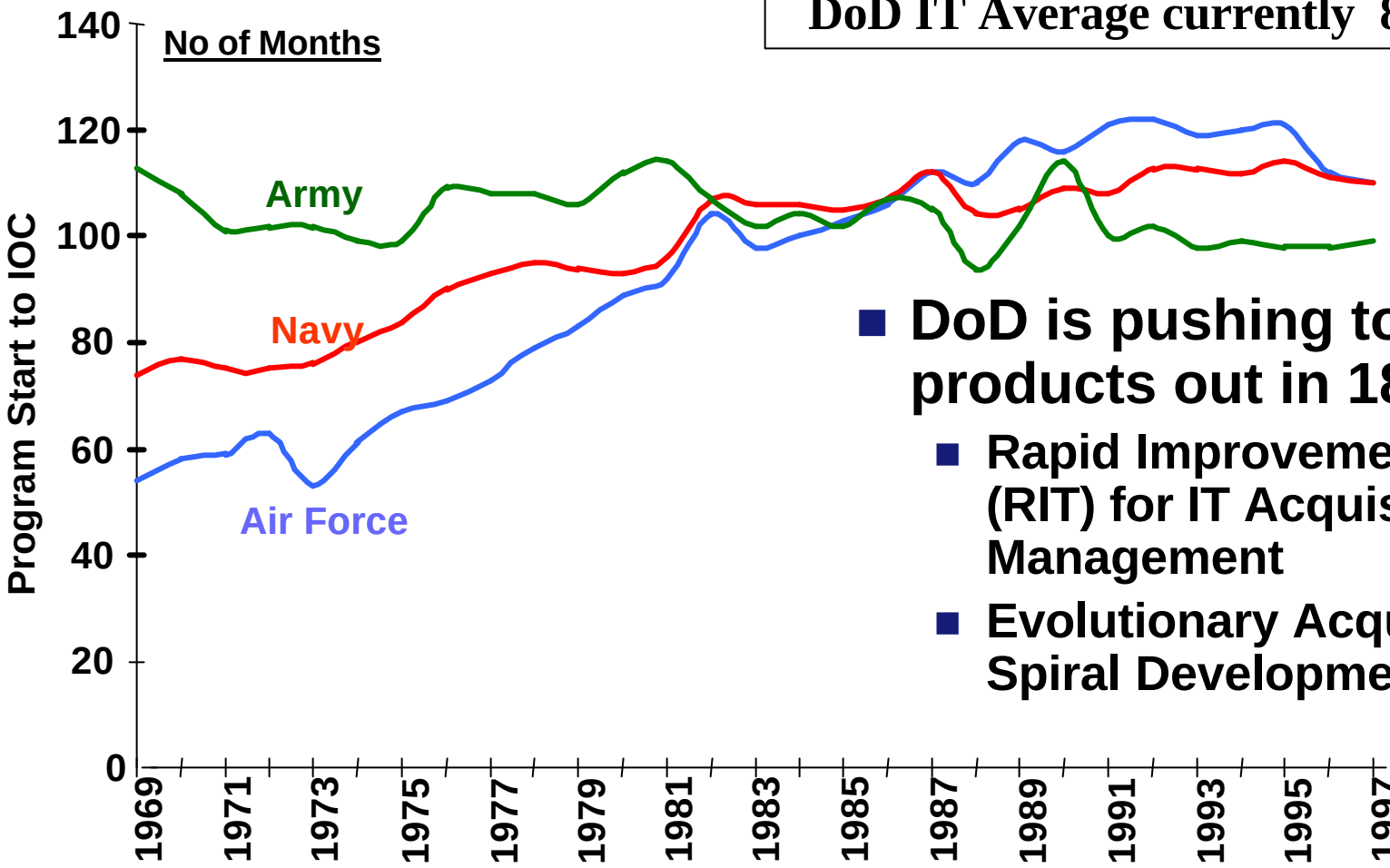
DoD IT Average currently 8-10 yrs



- DoD is pushing to get IT products out in 18 months
  - Rapid Improvement Team (RIT) for IT Acquisition Management
  - Evolutionary Acquisition Spiral Development

Source: DSB Briefing, Dan Czelusniak, 12 June 1998

Evolutionary Acquisition Spiral Development

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Evolutionary Acquisition[1]:

- An acquisition strategy to adapt to a changing environment by ***rapidly acquiring*** and sustaining a supportable ***core capability*** and incrementally inserting ***new technology or additional capability***.

Spiral Development:

- A risk driven process model generator used to guide concurrent engineering. It's two distinguishing features are a ***cyclic approach for growing definition*** and ***anchor points for stakeholder commitment milestones***. ***Prototyping*** is also used. [2]

- A ***cyclic model*** where ***resources*** stays ***constant*** but system ***size grows.***[3]

[1]Source: SAF/AQ 00; [2]Source: Barry Boehm, SEI/CMU brief Feb 00; [3]Source: Crosstalk Jan 95

IT Spiral Development & Acquisition Process Cycles

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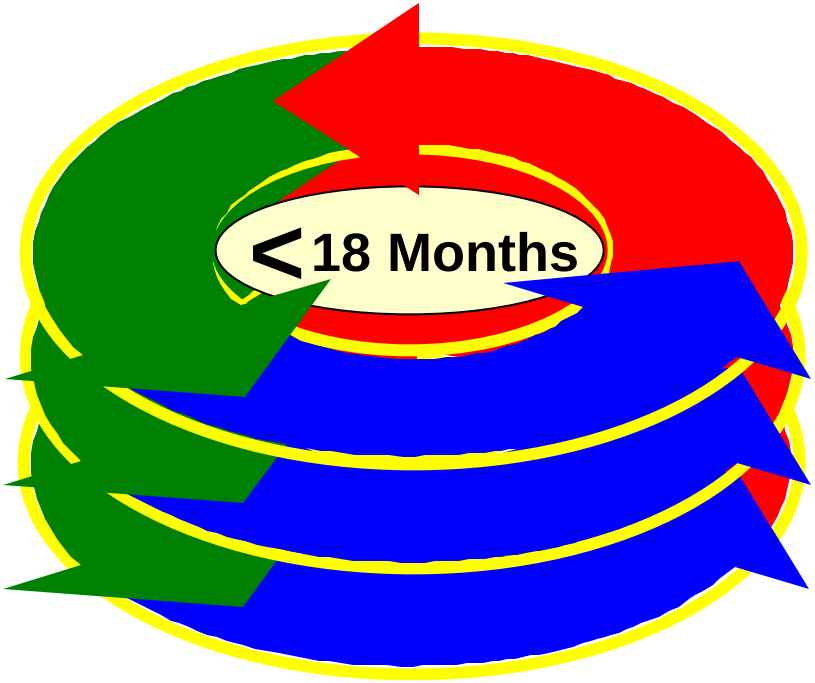
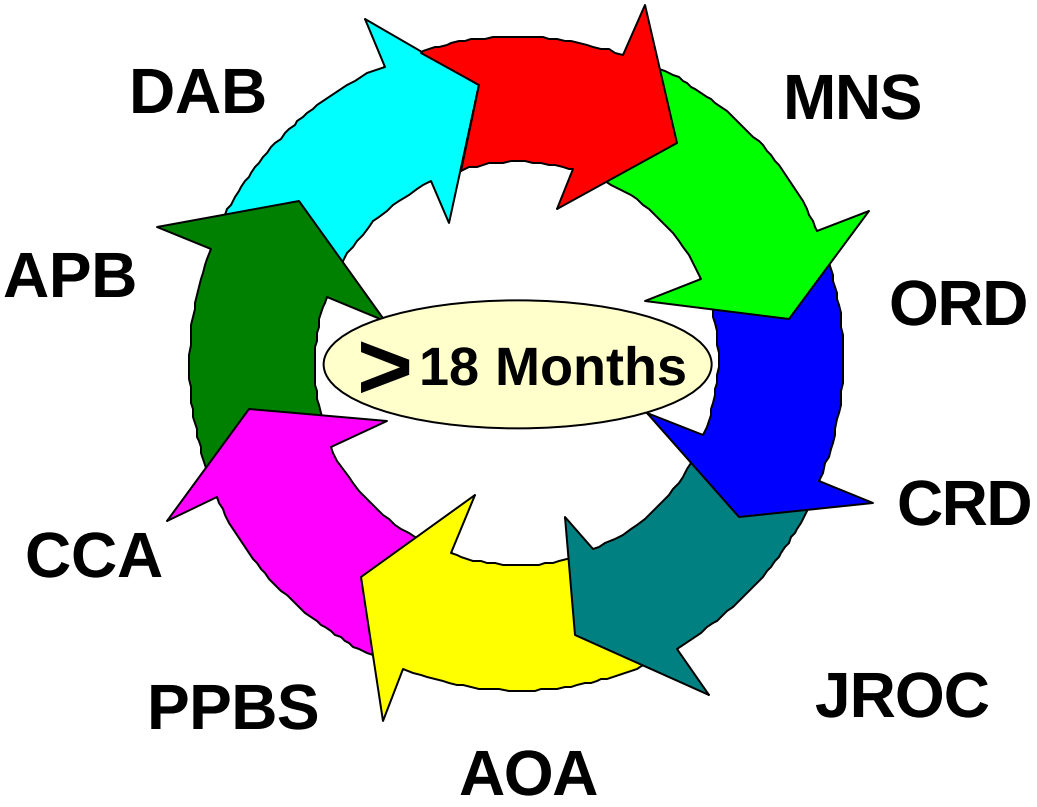
IT Spiral Development Cycle



Acquisition Process Cycle



DoDI 5000.2 - time consuming oversight process

Rapid Improvement Team Status

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- The services and OSD staff having been working during past few months to develop new approach for acquiring IT-intensive systems
- RIT briefed preliminary near- and long-term recommendations to Business Initiative Council
- 21 Dec – DOD CIO & DoD USD AT&L signed memo authorizing RIT pilots
- Pilots began 1 Jan 2002 and expire 31 Dec 2003

Rapid Improvement Team Pilot Projects

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- **Air Force:**
  - Global Combat Support System
  - Integrated Logistics Support
  - Integrated Maintenance Data System
  - Standard Contracting System
  - Financial Information Resources System
  - Global Transportation Network
- **Navy:**
  - Global Combat Support System, Maritime
  - Navy Tactical Command Support System
  - Navy Enterprise Maintenance Automated Information System
- **Army:**
  - Automated Information for Movement System II
- **DISA:**
  - Global Combat Support System
- **Health Affairs:**
  - Project to be named

Rapid Improvement Team Preliminary Recommendations

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- Preliminary recommendations include[1]:
  - Eliminating formal documentation of operational requirements for IT systems; Evolutionary acquisition
  - Increasing flexibility on IT systems funding
  - Delegating more oversight to the components rather than conducting reviews exclusively in the Pentagon
    - Provide ***oversight via insight*** using real time knowledge-based portals
    - No formal reporting – program assessments through review of program data via web portal
  - Replace Milestone Decisions with program feedback via Evolutionary Acquisition Decision Reviews

RIT continuing to work on policy development in conjunction with the 12 pilot projects

[1]Source: 3 Sept 2001 Federal Computer Week and AFPEO/C2 & CS 1/2 9/02 Briefing

Example: ISC2 Success Using EADRs

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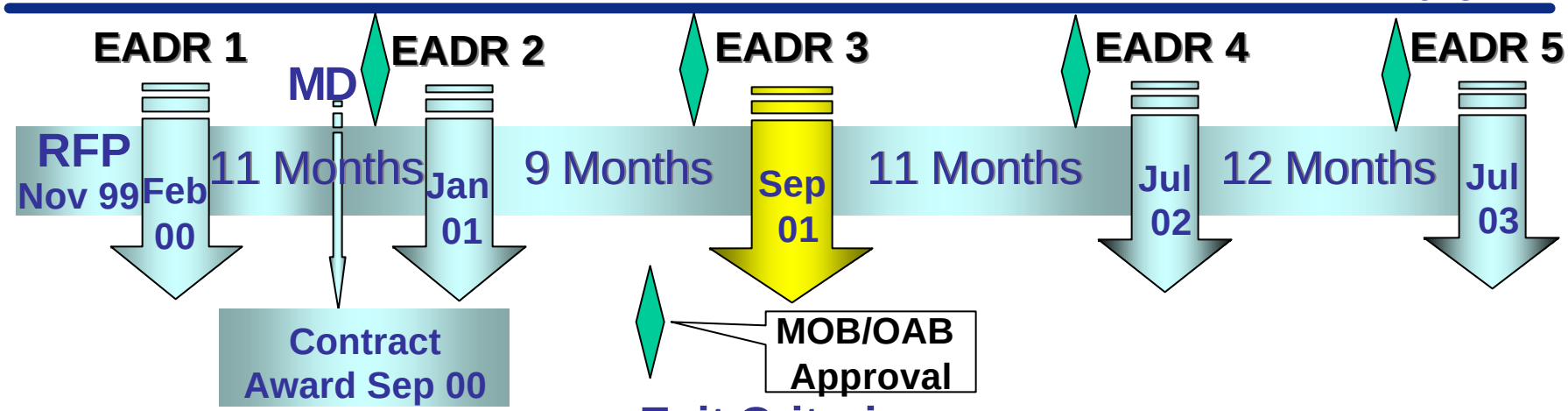

Exit Criteria

Approved:
- Requirements
- Funding
- Processes

Documentation
- MNS
- N/UWSS CRD
- CINC C2 CONOPS

Approved:
- Requirements
- Funding
- Incentive Plan

Documentation
- Evol Pgm Baseline
  - Year 1: APB
  - Yrs 2-8: Forecast
- SAMP
- TEMP

Approved:
- Requirements
- Funding

Documentation
- Evol Pgm Baseline
  - Year 2: APB
  - Yrs 3-9: Forecast
- Updates

Approved:
- Requirements
- Funding

Documentation
- Evol Pgm Baseline
  - Year 3: APB
  - Yrs 4-10: Forecast
- Updates

Senior Official Involvement Critical to Success

Cost Estimation Evolutionary Acquisitions

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- RIT Guidance to date focuses on reduction of documentation & associated oversight reviews
  - Requirements and funding are addressed at each review
  - Required cost estimating documentation has not been identified
    - Is cost agency documentation also eliminated?
    - Do frequency of decision reviews imply dedicated cost estimating support?

- Additional Cost Estimating Community Impacts:
  - Total LCCE or TOC estimates still required or will only incremental estimates be required?
    - For how many increments in the future? CARDs?
    - ROI implementations?
  - Statutory/Policy changes will be required
  - Possible solutions
    - Incremental estimates based on top level analogies to prior increments?
    - Build to Budget – Estimates no longer required?

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ERP - Background

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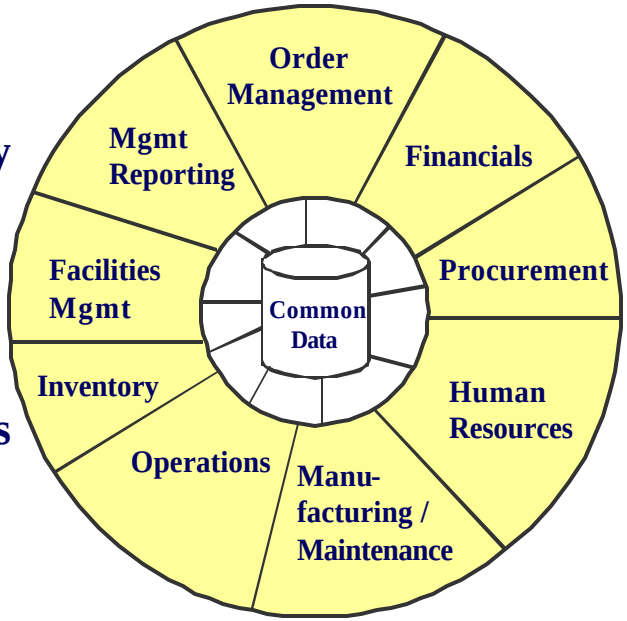
What is ERP (Enterprise Resource Planning)?

Revolutionary change in business processes for dramatic improvements



The integration of business processes that optimize functions across the enterprise (e.g., supply chain, finance, manufacturing/ maintenance, HR etc.)

ERP provides consistent & reliable information for timely decision-making and performance measurement

Background: ERP

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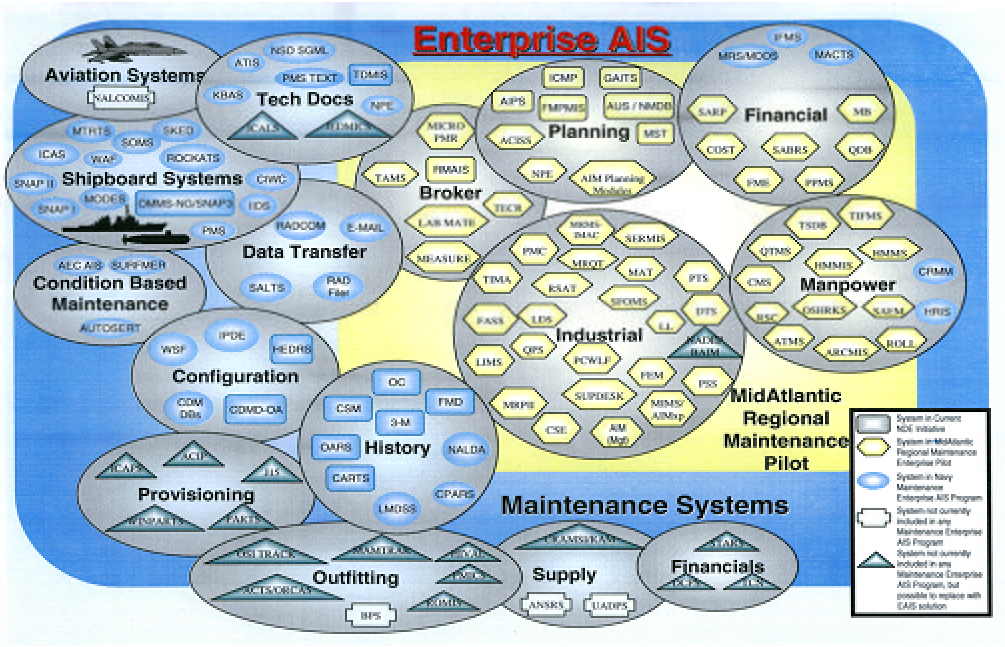
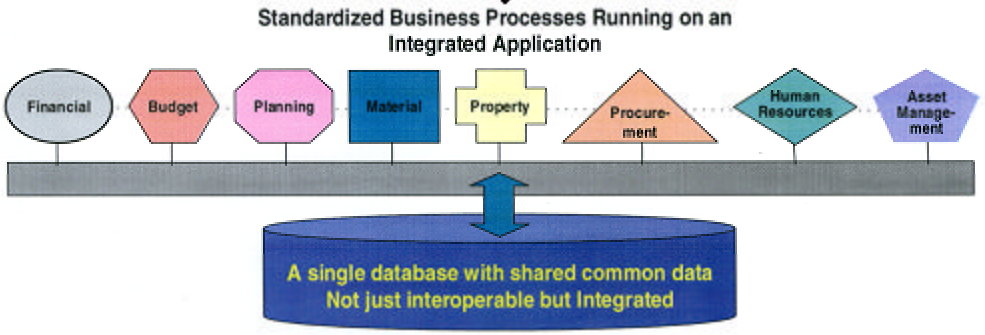


What We Have Today

What ERP Provides



ERP Solutions

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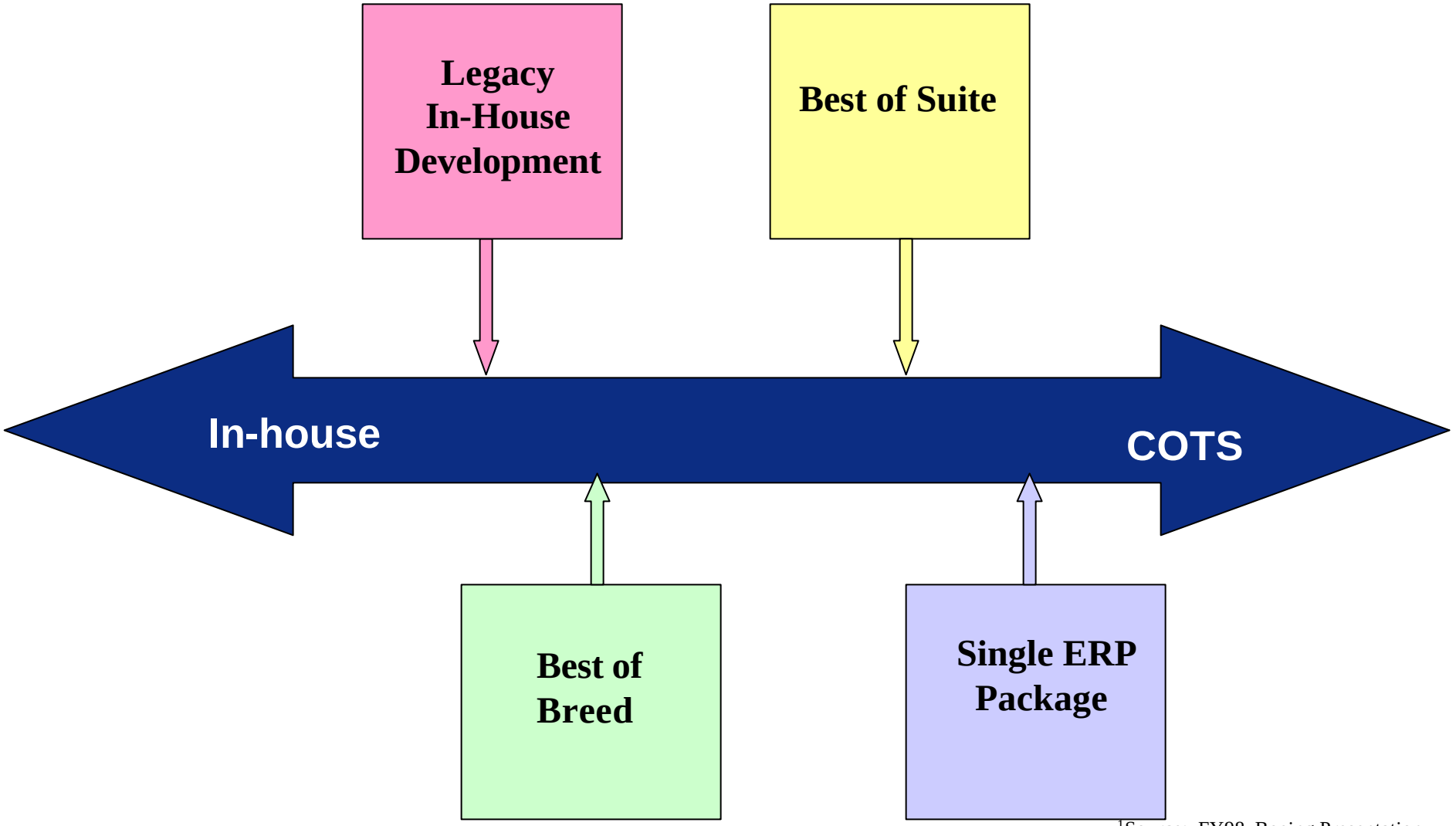

[1]Source: FY98 Boeing Presentation

ERP: To Be Environment

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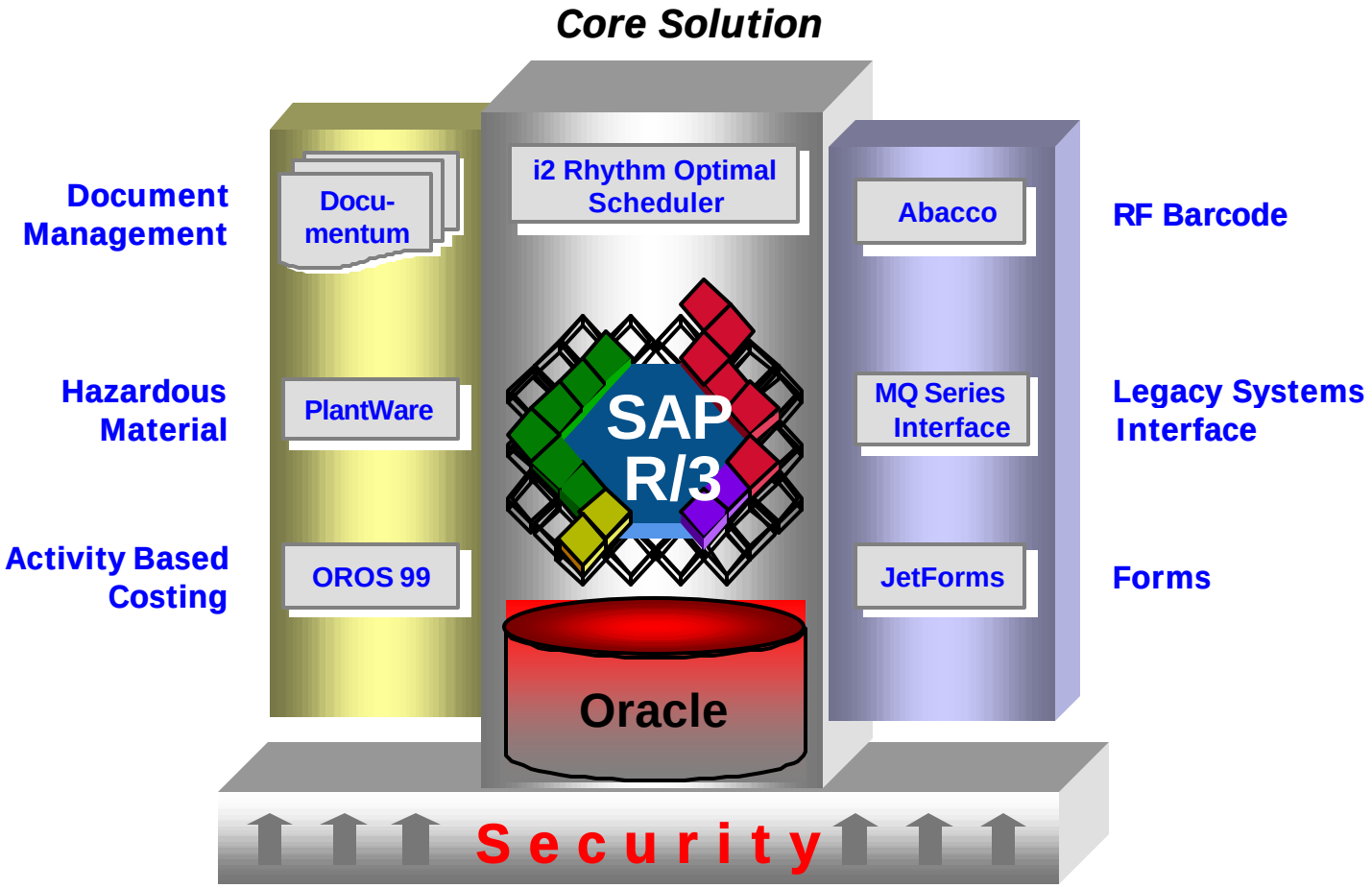

Software Architecture

ERP Implementation

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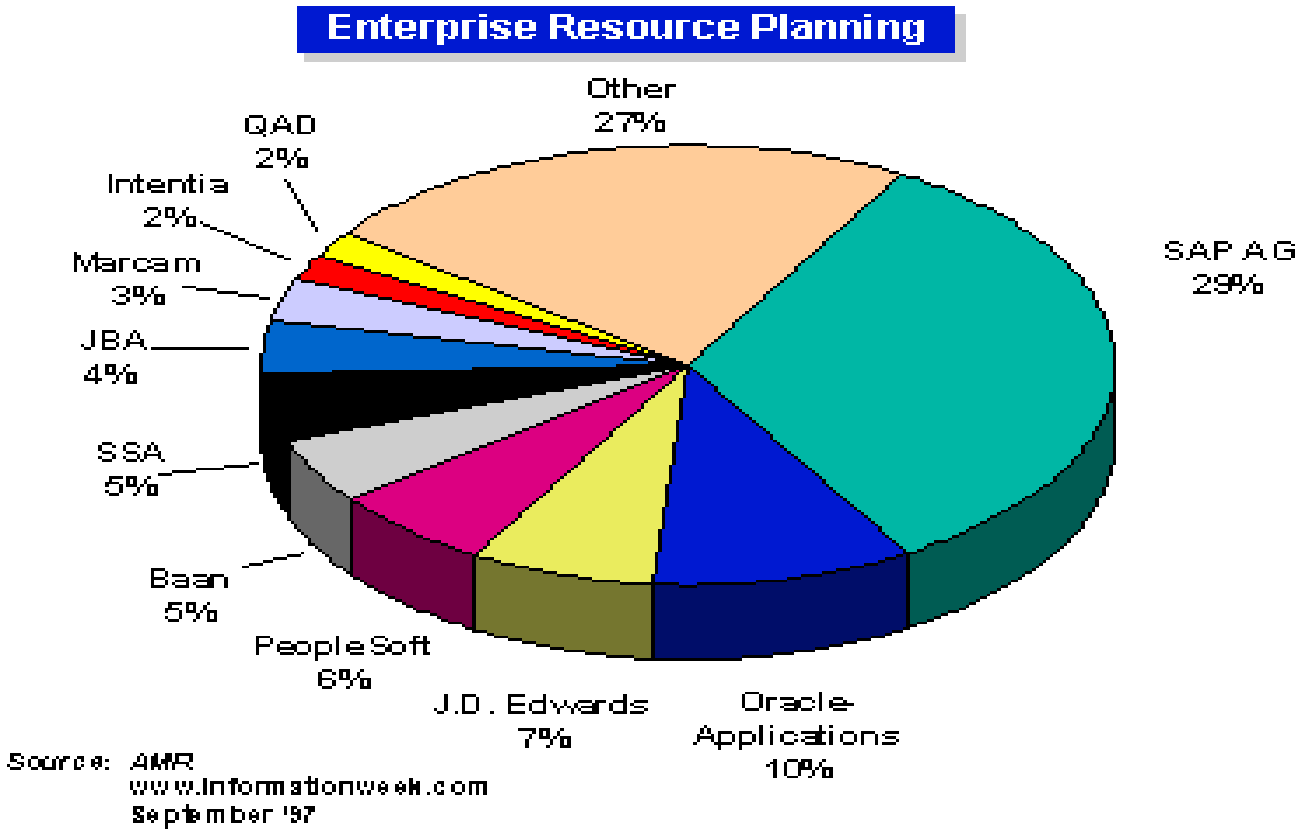

* Daniel O'Leary – *Enterprise Resource Planning Systems*

SAP R/3 Background

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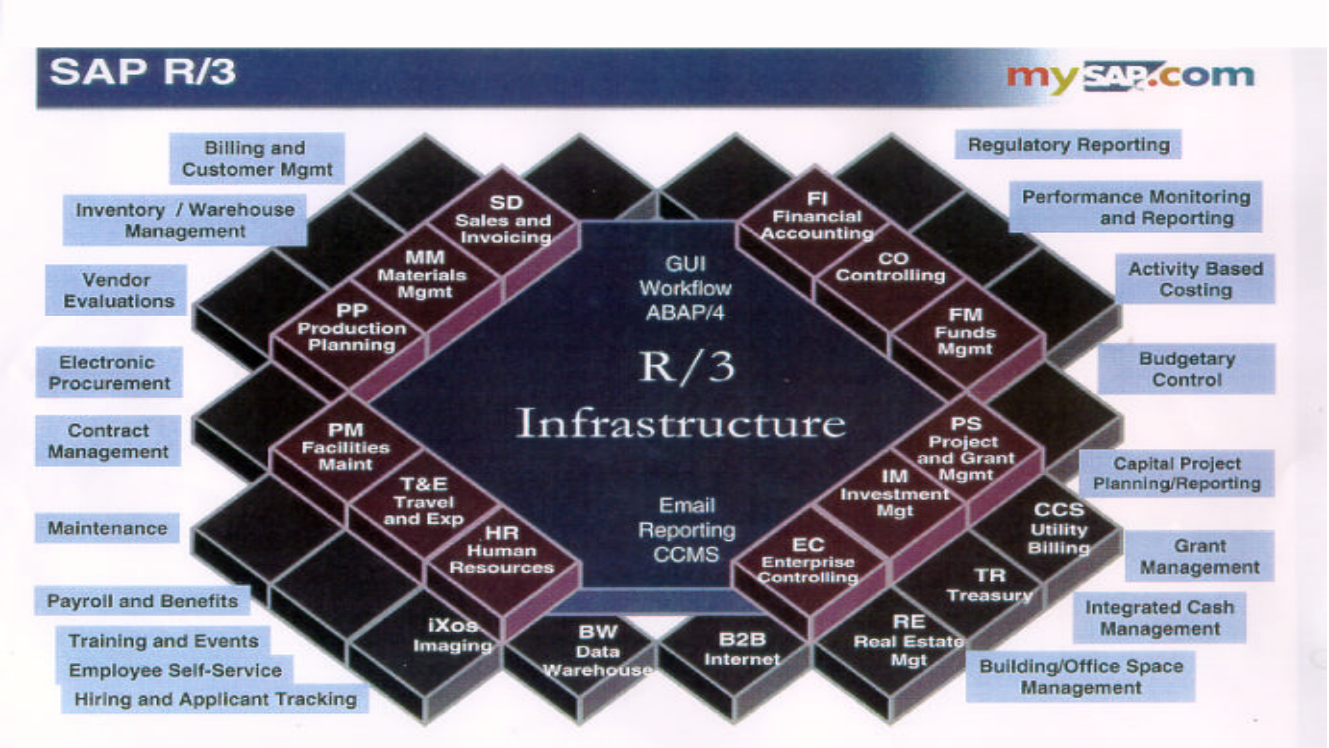
SAP - Systems, Applications & Products in Data Processing

R/3 - Runtime System Three

Founded in 1972, Mannheim, Germany. Objective was to develop a package that could integrate business solutions to get a better return on information.



SAP is best known for their manufacturing/supply chain capabilities

ERP: Background

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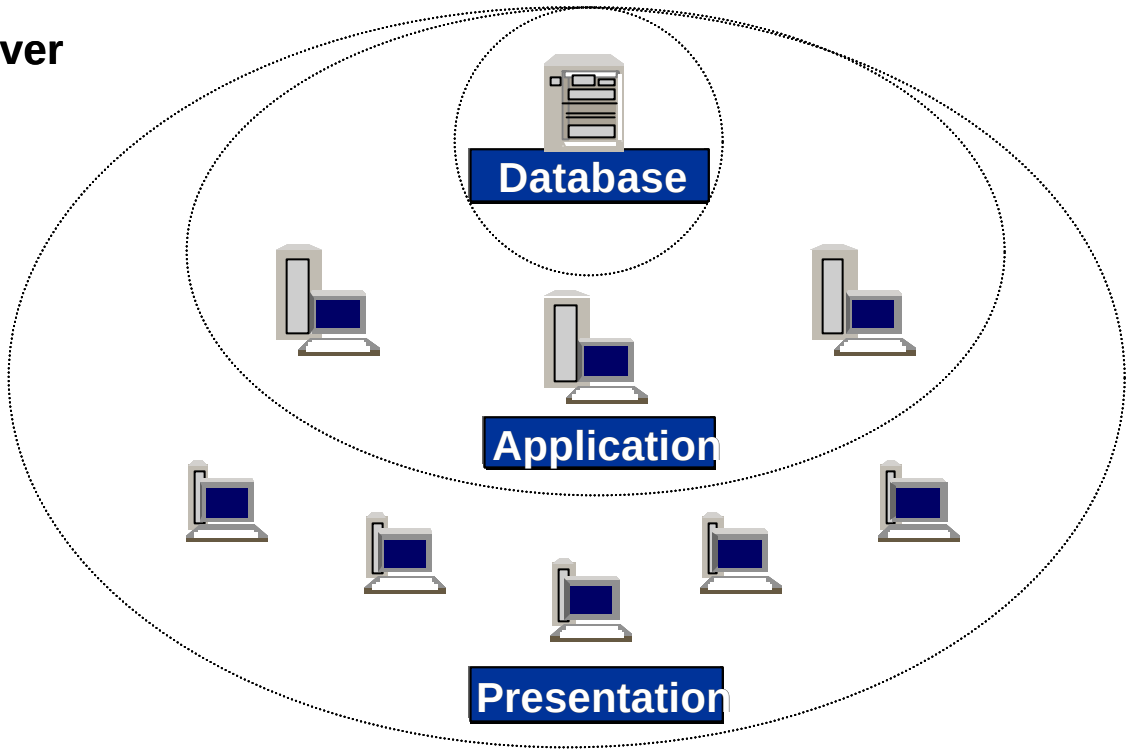
System Architecture

Three-tier Client/Server



3 layers

Database

Business logic

User Interface

SAP R/3 + MySAP and PeopleSoft version 8.0
Reflect Web-enabled technology

ERP Implementation

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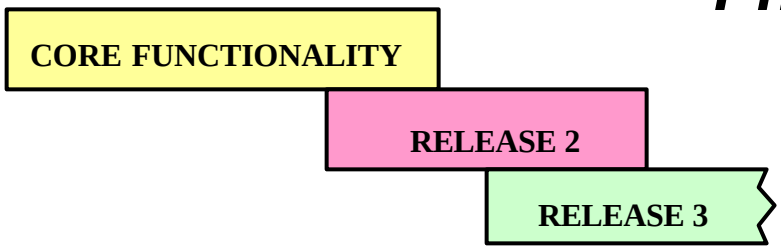
Big Bang Implementation – *an entire suite of ERP applications is implemented at all locations at the same time.*

- All relevant processes are chosen/developed and implemented in the software.
- All modules are tested individually and for their interfaces with other modules.
- Legacy turned off, new system turned on.



Phased (Incremental) Implementation *– modules are implemented one at a time or in groups. Each goes through:*

- Design
- Develop
- Test
- Install

[1] Daniel O'Leary – *Enterprise Resource Planning Systems*

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Typical SAP ERP Implementation Process

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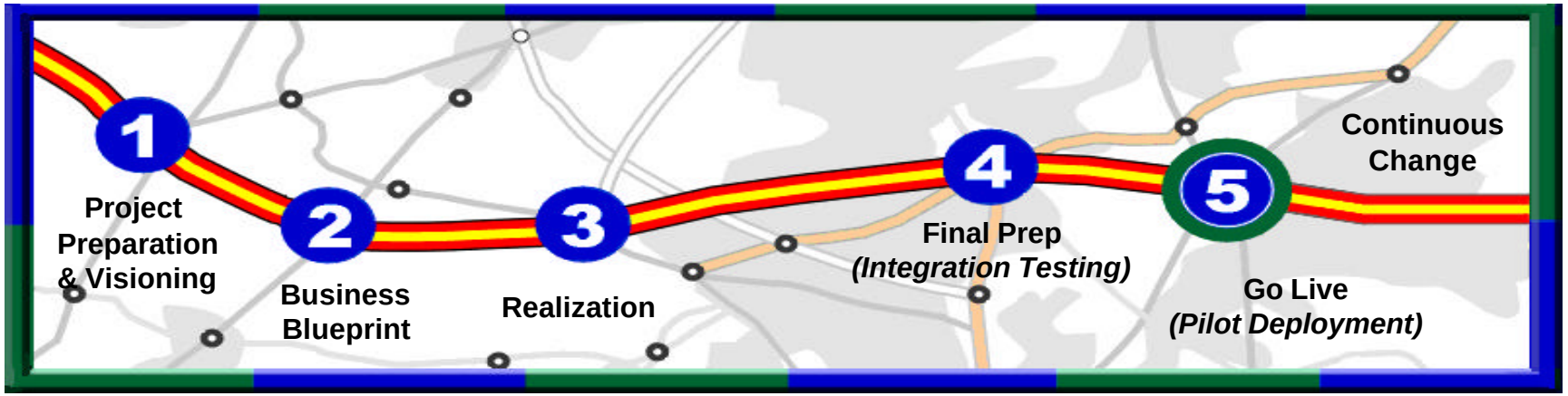

- Project Preparation –
  - Coordinate Senior Level Mgt Support
  - Define objectives and expectations
  - ID decision making process
  - Define Team
- Business Blueprint –
  - BPR & Gap Analysis
  - Fine tuning project goals
  - System Environment Set-up
  - Detailed tuning of implementation plan
- Realization – Configuration of SAP R/3 System
  - Data conversion/migration program development
  - Creation of reports & forms
  - Interface development
- Final Preparation –
  - End User Training
  - System Testing
  - Data Migration
- Go Live and Support

ERP OVERSIGHT AND ACQUISITION

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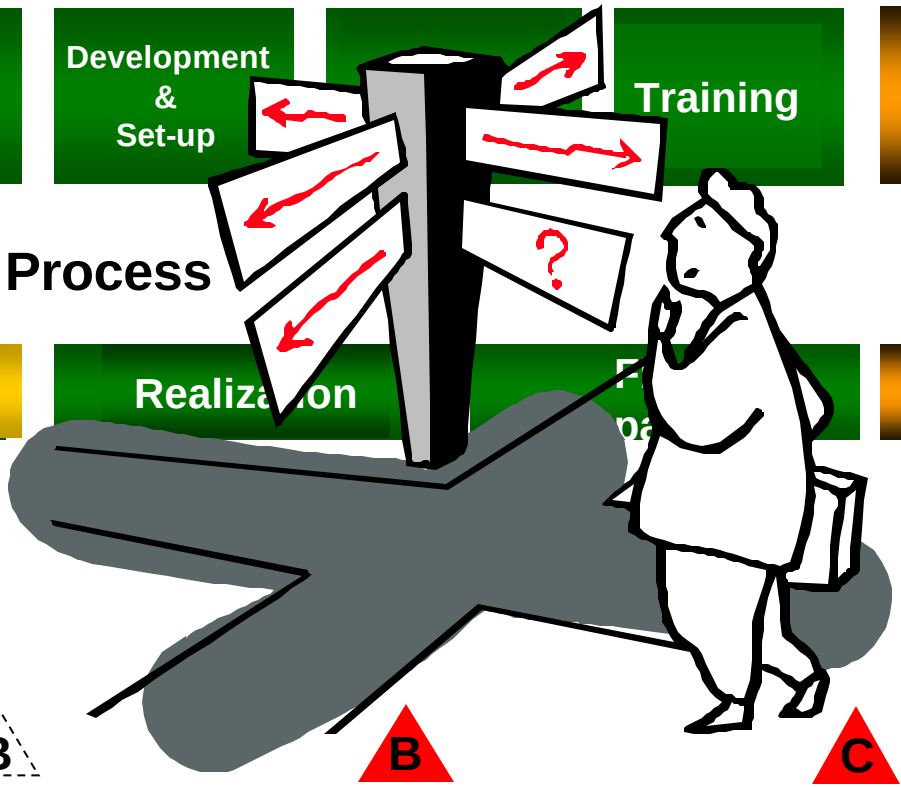
PeopleSoft ERP Acquisition Process

Pre-purchase Planning | Project Planning | Prototyping | Development & Set-up | Training | Roll-out

SAP ERP Acquisition Process

Project Prep | Business Blueprint | Realization | Go Live & Support



DoD 5000 Acquisition Milestones

A | A | B | B | C

Concept Exploration | System Development & System Integration | Systems Demonstration | Operations and Support

Current DoD ERP Pilots & Programs

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- **Navy:**
  - Cabrillo ERP - SPAWAR NWCF
  - Supply Maintenance Aviation Re-engineering Team (SMART) - NAVSUP and NAVAIR
  - Sigma - NAVAIR PM ERP Pilot
  - Navy Enterprise Maintenance Automated Information System (NEMAIS) – NAVSEA
  - Navy Standard Integrated Personnel System (NSIPS)
- **DoD:**
  - Defense Integrated Military Human Resources System (DIMHRS) – Navy lead
  - Business Systems Modernization (BSM) – DLA lead
  - Defense Civilian Personnel Data System – (DCPDS) – OPM lead
- **Army:**
  - Wholesale Logistics Modernization Program (WLMP)
- **Air Force:**
  - Logistics Enterprise Application Integration (EAI) Efforts

Other Federal Agencies ERP Efforts

- Dept of Agriculture – CAMS project (HR)
- Dept of Energy – CHRIS project (HR)
- Dept of State – GEMS project (HR)
- Dept of Treasury (US Mint) – COINS project (HR/Manuf)
- Dept of Treasury – HR CONNECT project (HR)
- Dept of Veterans' Affairs – HR LINK$ project (HR)
- Dept of Transportation - US Coast Guard – CGHRMS project (HR)

Findings

- **COTS fit relatively high**
  - Majority of agencies experiencing +80% fit on initial HR implementations
  - Supply chain solutions to experiencing similar fits, however extensive bolt-ons and interfaces are required
  - Expect fit to decrease as follow-on releases (additional modules) are implemented
    - More complex, less mature modules yet to be implemented
  - True Business Process Reengineering has to occur to maintain a high COTS fit (often requires policy changes & paradigm shifts)

- **Sizing Metrics are not standardized**
  - SLOC and FP metrics seldom used
  - Object Counts & requirements were more common

Findings
(cont'd)

- **Maintenance/Upgrade Efforts**
  - SW Upgrade every 18 months on average
  - New functionality available with each SW release
    - Customization effort has to be revisited
    - Recurring integration efforts required
- **Development Team composition crucial**
  - Most agencies utilized small development teams (15-50) with experienced PS integrators (high MY rates)
  - Separate upgrade teams (5-10) also small, but specialized
  - Non-SW developmental activities (configuration management, data base administration, database conversion, training) were significant

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Findings
(cont'd)

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- **Early Mock-ups and Incremental deployments essential**
  - Subject matter expert participation essential
  - Promotes user buy-in

- **Program Manager empowerment is key**
  - PM control over legacy systems (including budgets) is essential
  - PM authority to implement change in business practices key to success
  - Corporate (top-level) management support essential

Findings
(cont'd)

Benefits

- **Human Resources/Program Management**
  - Benefits experienced generally fit into three categories:
    - Large ROI and direct cost savings due to functional end-strength infrastructure cuts
    - Large ROI and minimal direct cost savings due to reallocation of functional end-strength billets to other areas
    - Minimal ROI and direct cost savings due to inability to turn off legacy systems and/or cut functional end-strength
  - Majority of HR agencies have not realized significant benefits yet
  - Legacy turn-off and HR personnel redirection essential
- **Manufacturing/Supply Chain**
  - Anticipate inventory reductions will drive Supply chain ERP savings
  - Identifying actual dollar savings difficult due to decentralized budget lines
- **Business Case Analysis has to recognize program boundaries**
  - Benefits often stop at the program boundaries
  - Need a true "Enterprise" solution for dramatic benefits
  - External customer dependencies on legacy systems must be considered

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Outline

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- **MAIS programs**
- **Clinger-Cohen Requirement**
  - Business Process Reengineering
  - Alternative of Analysis
  - Economic Analysis
  - Performance Measures
  - Information Security
- **Other AIS Challenges**
  - IT Cycle Time Reductions
  - Enterprise Resource Planning (ERP) Systems
- **Cost Estimating Implications**
  - **Current Processes**
  - ERPs
- **Summary**

ERP
Cost Element Structure

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- **ERP SW Development/Implementation effort consists of:**
  - **1.1 - Program Management**
  - **1.2 – Concept Exploration - Business Process Reengineering**
  - **1.3 – System Development**
    - **1.3.3 - Software Development**
      - Gap Analysis
      - BPR
      - COTS integration
      - Custom Code Development
      - Unit level Test
    - **Database conversion/migration**
    - **Interface development**
    - **System Engineering**
    - **Training**
    - **System Test & Evaluation**

Software Estimation

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- **SW projects are still experiencing significant growth[1]**

Category	1994 Study	2000 Study
% Successful projects (on budget & schedule)	16%	28%
%Cancelled	31%	23%
% Experiencing Cost and/or Schedule growth	53%	49%
% Cost Growth	189%	45%
% Schedule Growth	222%	63%
% of Planned Functionality Actually Delivered	61%	67%

- **Defense Science Board made the observation that most of their 130+ recommendations have yet to be implemented**
  - **Only 3 are in practice**
  - **Only 18 are in policy**

Source: FY2000 Defense Science Board Report – The Standish Group Chaos Study 1994 & 2000

Software Estimation Typical Steps

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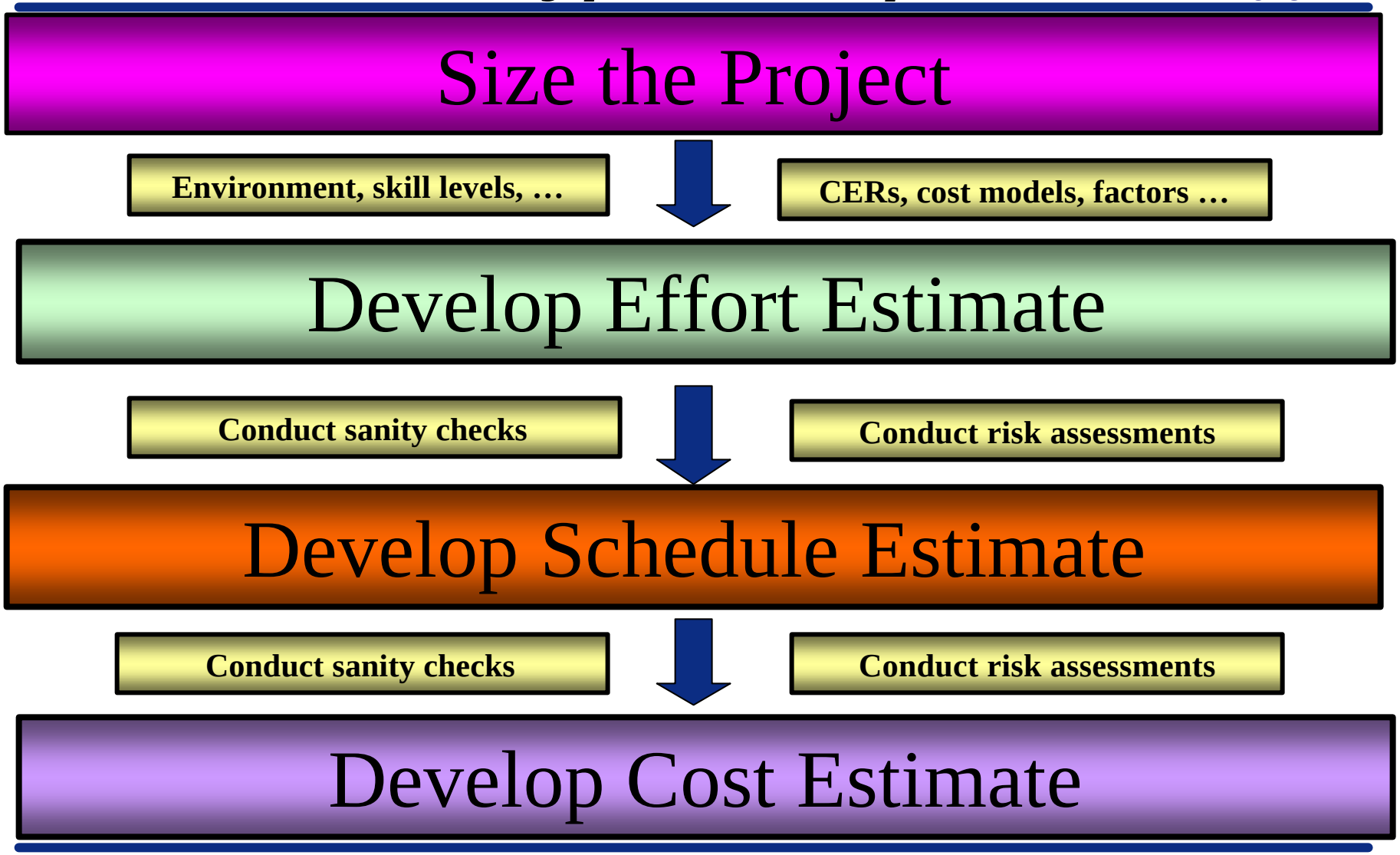
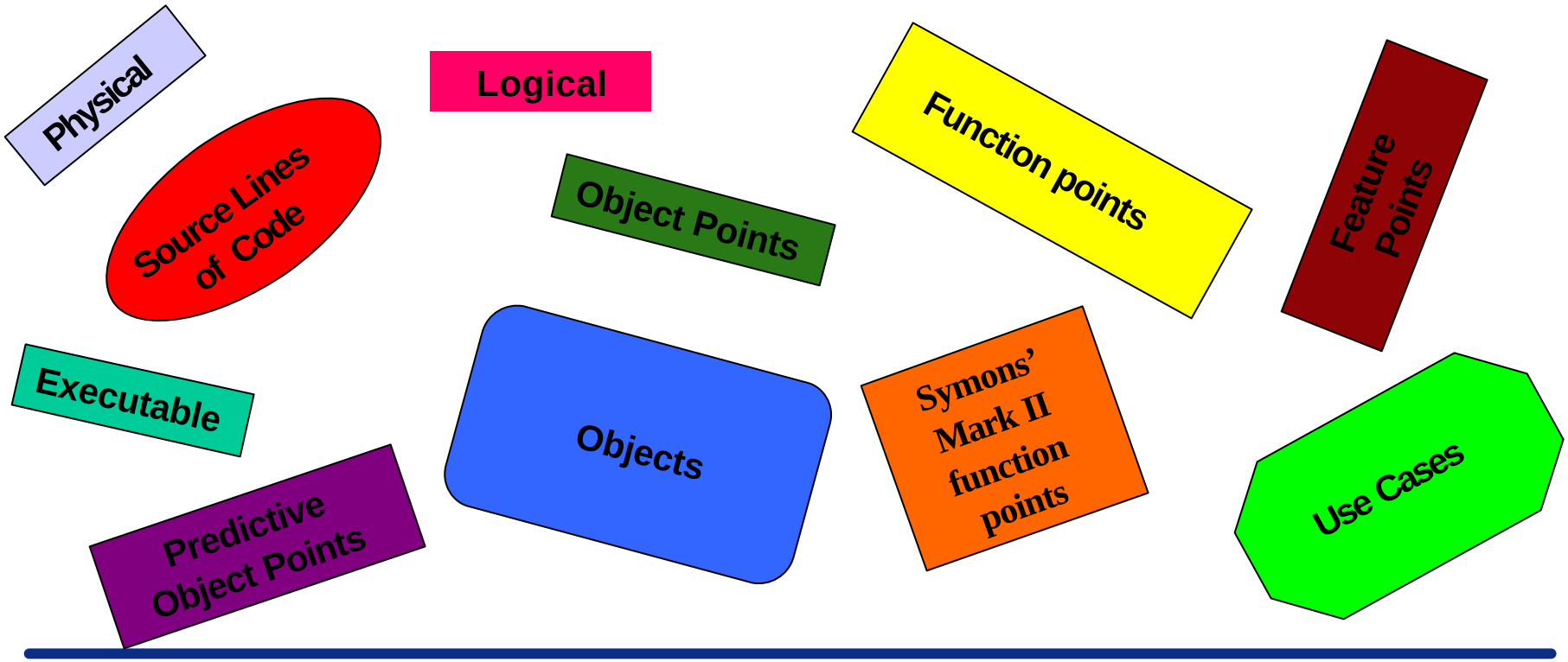


Size the Project

Requirements – a measure of the functionality required



Software Cost Estimation Standard Procedures

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Environment, skill levels, …

CERs, cost models, factors …

Develop Effort Estimate

Methodologies:

- Cost Models
  - Historical data
  - Theoretical research
- Analogy
- Engineering Judgment
- Combination of those listed above

Require calibration to reduce variance and ensure applicability

71% of DoD cost estimators sampled currently use cost models

Estimating Differences

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Do new technologies, methodologies or approaches

new metrics and estimating approaches?

What are the real differences?

Software Estimation Historical Perspective

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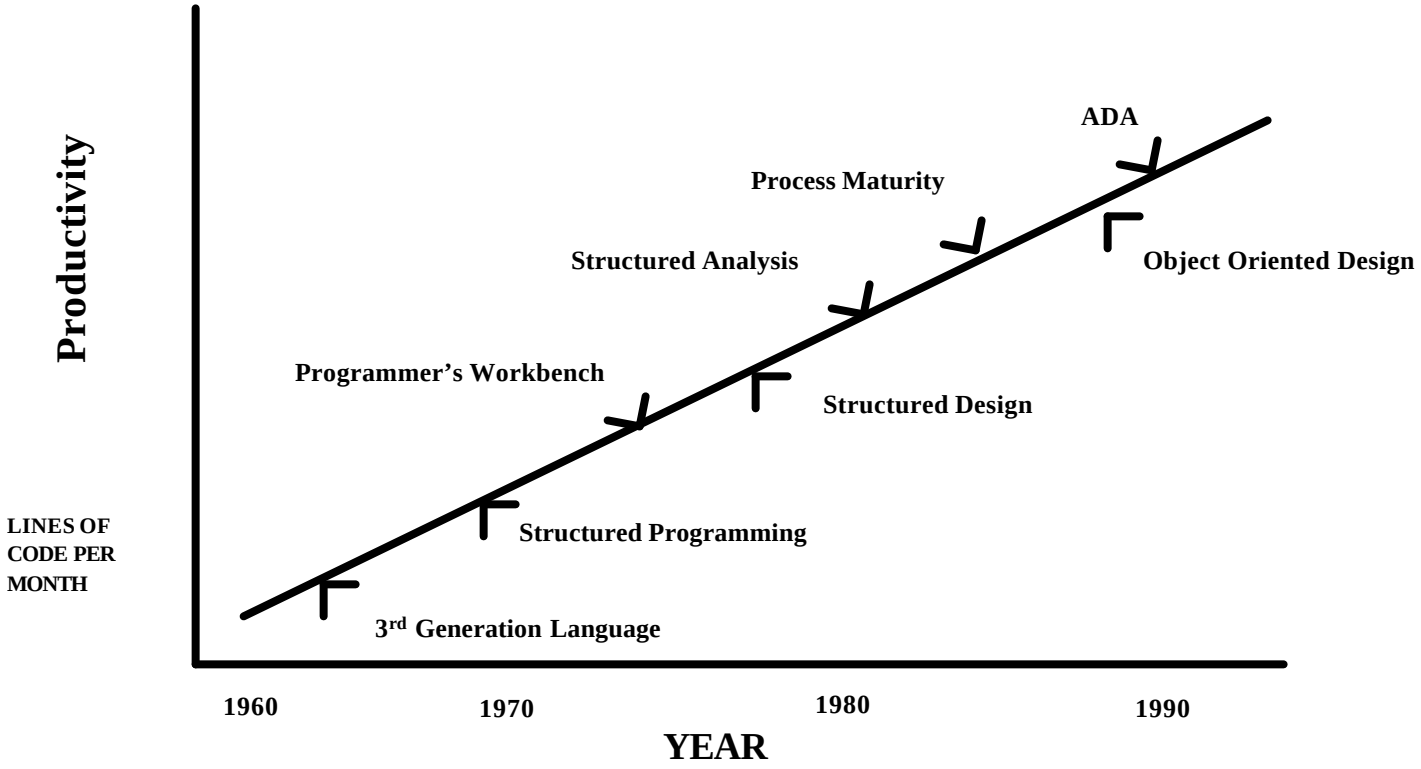

- SW productivity has grown linearly from 1960 through 1990, however, the growth of software development productivity shown has been less than one source line of code per person-month per year for the entire 30-year period

Source: July 2001 Crosstalk article SW estimating Model Calibration By Dr. Randall Jensen

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Software Estimation Historical Perspective

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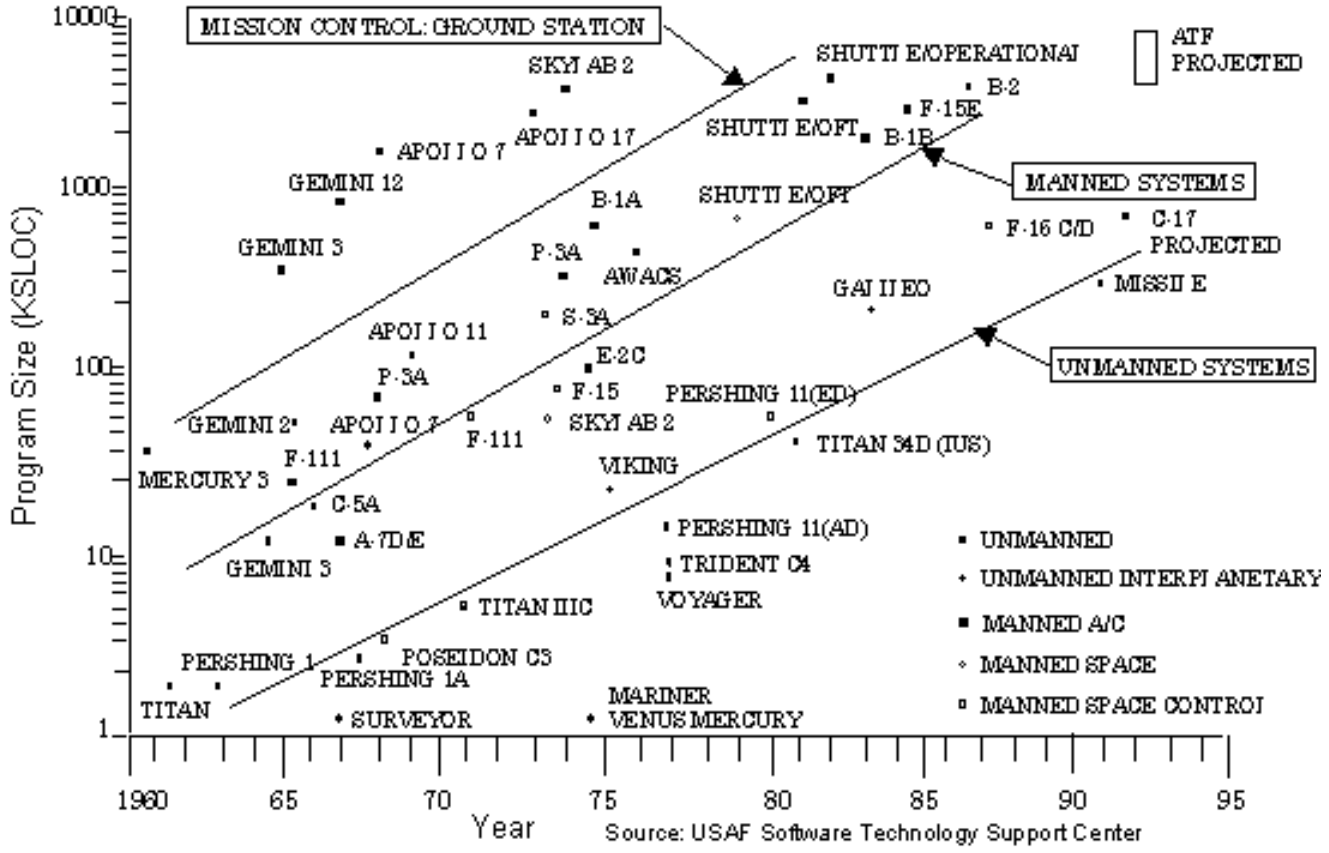

SW size has also increased linearly from 1960 through 1990

Software Estimation Historical Perspective

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- QSM RESEARCH[1]:

Metric	1982-1985	1994-1997	1997-2000
Productivity Index	13.8	17.4	16.6
Effort (Man-Months)	167.7	54.2	106.1
Schedule (months)	28.7	8.1	9.4
Reused %	59%	65.3%	48.7%
MTTD (days)	5.5	9.0	12.5
Size Effective KSLOC	84.1	47.2	96.8

- Over an 18 year period, productivity has improved 20 LOC/day
- Why the difference?
  - IT versus weapons system? Size or complexity of application? Increments vice total program?

[1]**Source: From the QSM Database: Productivity Statistics Buck 15 Year Trend by Doug Putnam**

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Outline

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- **MAIS programs**
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  - Business Process Reengineering
  - Alternative of Analysis
  - Economic Analysis
  - Performance Measures
  - Information Security
- **Other AIS Challenges**
  - IT Cycle Time Reductions
  - Enterprise Resource Planning (ERP) Systems
- **Cost Estimating Implications**
  - Current Processes
  - **ERPs**
- **Summary**

ERP Software Estimation

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- Software Development for ERPs consists of:

Estimating Approach

- SW requirements → Still required; no change
- Gap Analysis → New requirement?
  - BPR → New requirement?
  - COTS Integration → Possible differences?
  - Custom Code Development → Possible differences?
    - Model Configuration
- Unit/Regression/System Level Test → Still required; no change

ERP Software Estimation COTS Integration

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- **SW Development Phases**
  - Planning
  - Implementation
  - Component Test
  - System Test

Taskings eliminated due to COTS account for 42% of SW development[1]

Develop Size & Effort Estimate

- **Sizing models:**
  - **Barry Boehm – COCOMO II Model -** Allows you to adjust adaptation factors to reflect the taskings still required
  - **NCCA –** quantitatively solves for the equivalent code conversion factor (efactor) which adjusts effort to reflect this difference
- **Effort models:**
  - Productivity comparable to other SW development efforts

Current tools allow us to estimate this facet of ERP SW Development Cost Estimating

[1]Source: Software Engineering A practitioner's approach (Roger S. Pressman) © Ian Davis

ERP Software Estimation
Customized Code Development

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Develop Size & Effort Estimate

- **Configuring the Model:**
  - Sizing models: appropriate metric?
    - # of modules implemented
    - # of req'ts satisfied
  - Effort models:
    - LOE?; f(req'ts)?; % of customization?

- **Customized development (screens, reports, queries ...)**
  - Sizing models:
    - SAP – ABAP code; PeopleSoft – Peoplecode
    - Objects, Use cases, …
  - Effort models:
    - Similar to previous development efforts (hrs/object; hrs/UML use case, …)

Size of the ERP implementation = 1) COTS integration effort (bolt-ons) +
2) amount of initial configuration +
3) customized development to satisfy gap

Configuration Sizing & Estimation is currently a challenge, but estimating metrics for other elements is comparable to traditional development efforts.

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ERP
Non-SW Development Activities

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- **ERP SW Development/Implementation effort consists of:**
  - **1.1 - Program Management**
  - **1.2 – Concept Exploration - Business Process Reengineering**
  - **1.3 – System Development**
    - **1.3.3 - Software Development**
      - **Gap Analysis**
      - **BPR**
      - COTS integration
      - Custom Code Development
      - Unit level Test
    - **Database conversion/migration**
    - **Interface development**
    - **System Engineering**
    - **Training**
    - **System Test & Evaluation**

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ERP
Anticipated Estimating Changes

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COST ELEMENT STRUCTURE	ANTICIPATED IMPACT	COST EST CAPABILITY
Program management	Estimating approach similar; Larger involvement from SMEs throughout implementation effort	
BPR/Gap Analysis	True BPR didn't occur previously; Effort and time to obtain waivers is extensive and unknown	
Data Conversion	Development approach similar; Configuration management increases due to new management of new COTS releases.	
Interfaces	Estimating approach similar; Quantity and complexity of interfaces may change	
Training	Estimating approach similar; BPR has caused scope of training to increase	
System Engr & T&E	Estimating approach similar; anticipate no major changes	

Standard AIS vs ERP Comparisons

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Traditional AIS Projects versus ERPs

Cost Element	Trad	ERP	% Delta
Program Management	15%	10%	-35%
Concept Exploration/BPR	3%	13%	306%
Systems Engineering / System Implementation	52%	40%	-23%
System Procurement	17%	17%	1%
Other	13%	20%	54%
Total	100%	100%	

Source: NCCA standard factors

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Standard AIS vs ERP Comparisons

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Source	Cost Growth	Schedule Growth
Meta Group ERP Study	90%	120%
NCCA ERP Programs	86%	33%
FY94 Standish Chaos Study (IT programs)	189%	222%
FY00 Standish Chaos Study (IT programs)	45%	63%

ERP Estimation Conclusions

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- "ERPs involve estimating project size and not just software size, where project size is the measurement of[1]:
  1) how many business processes are being configured,
  2) how many modules of the base system will be utilized, and
  3) how many modules will be modified or affected by interface development"

- ERP SW developments appear comparable to traditional development efforts (if not more efficient), however sizing metrics are a challenge.
  - No metric is completely fool proof
  - Application of CERs and staffing profiles need to be adjusted to reflect development and upgrade cycles.

- ERP non-SW development efforts also appear comparable, however, additional resources can be anticipated to perform BPR, training and configuration management.

ERP does not imply a radical change in estimating methodologies

[1]Source: Estimating ERP developments by Robert Ward, QSM

Future Efforts

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- Continue data collection efforts:
  - To date – data collected on approximately 30 traditional development programs
  - To date – data collected on seven ERP development programs; data arriving on five+ more shortly
- Identify cost drivers & associated technical parameters
  - Sizing the Project versus the software development effort
  - Investigate relationship between UML use cases & other Object Oriented metrics versus effort

GOAL: To quantify the impacts in both SW development & non-SW development activities due to changes in developmental or acquisition strategies

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Outline

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- Cost Estimating Implications
  - Current Processes
  - ERPs
- **Summary**

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Summary

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- Appreciation for MAIS programs
- Understanding of the Clinger-Cohen Act
- Introduction to AIS challenges and the associated cost estimating implications

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  Theresa.O'Brien@pentagon.af.mil

BACKUP

Client/Server Configurations

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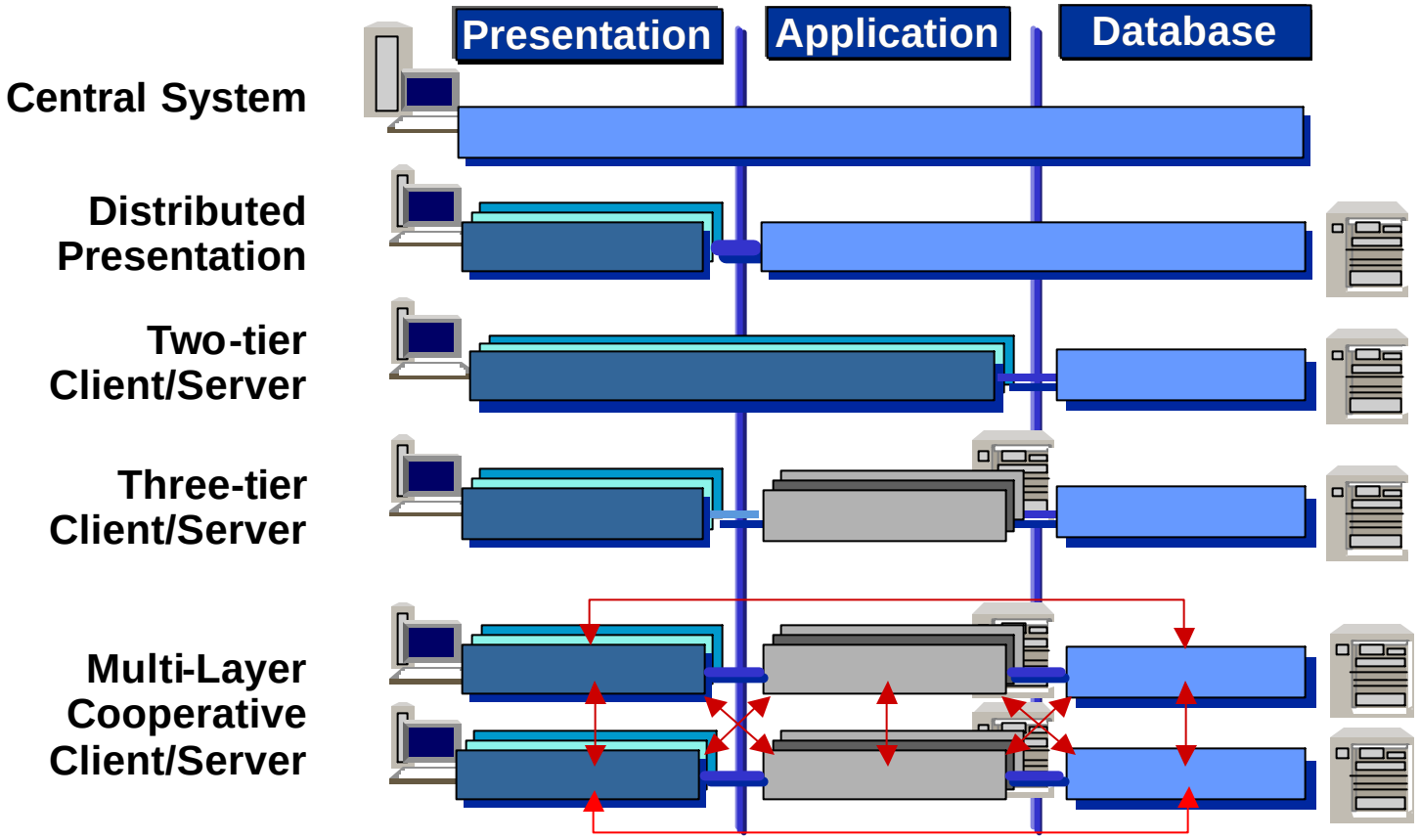

* Rudiger Buck-Emden, *The SAP R/3 System*

Cost Estimation Evolutionary Acquisitions

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- **Current research implies that Evolutionary Acquisitions:**
  - **Shorten initial time to market**
  - **Allow program managers to better manage risk**
  - **Capitalizes on new DoD 5000 acquisition process**
  - **Exponential nature of most SW cost models implies greater productivity and shorter schedules due to smaller sized increments**
  - **Time phasing will change - typical Raleigh curve probably replaced with a flatter labor distribution**
  - **Type of evolutionary development will also affect overall progra m cost**
    - Exploratory programming versus throw-away prototypes may influence total cost
  - **However, due to nature of evolutionary acquisitions**
    - **Program development life may span decades**
    - **Implies evolutionary fielding which may increase fielding, training and other sustainment costs**

SOFTWARE

Other CES elements

Implication is that profile adjustments are required

Cost Estimation Evolutionary Acquisitions

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- **EA – implies smaller increments, more frequent implementations; evolving requirements** ⟹
- **What are we currently doing?**
  - **Current process incremental vice evolutionary (i.e., requirements determined up front); Big bang - waterfall approach basically non-existent**
    - Consistent updates to ORD make current processes even closer to evolutionary
  - **Cycle times now?**
    - Current programs have been utilizing the release/block philosophy for some time now
      - **Start – FY98**
      - **R1 – Feb 00**
      - **R1.1 – Jul 00**
      - **R2 – Sep 01**
      - **R4 – 1Q 02**

      Start – FY96
      R1 – Mar 98
      R2 – Jun 01
      R3 – 4Q 02
      R4 – 1Q 04
    - Overall average cycle times were 16 – 24 months per release and productivity factors were improving
  - **Maybe learning curves should be applied to follow-on releases**

PeopleSoft: Background

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PeopleSoft was founded in 1987 and went public in 1992.
PeopleSoft is one of the top five ERP vendor.

- Suites:
  - Financials
  - Distribution
  - Manufacturing
  - HR Mgmt System (HRMS)
  - PeopleTools

- **Human Resources**
  - **Position Mgmt**
  - **Competency Management**
  - **Career Planning**
  - **Training Administration**
  - **Health & Safety**
  - **Base benefits**
  - **etc.**
- **Payroll**
- **Payroll Interface**
- **Time & Labor**
- **etc.**

PeopleSoft is best known for its human resources capability

Typical PeopleSoft ERP Implementation Process

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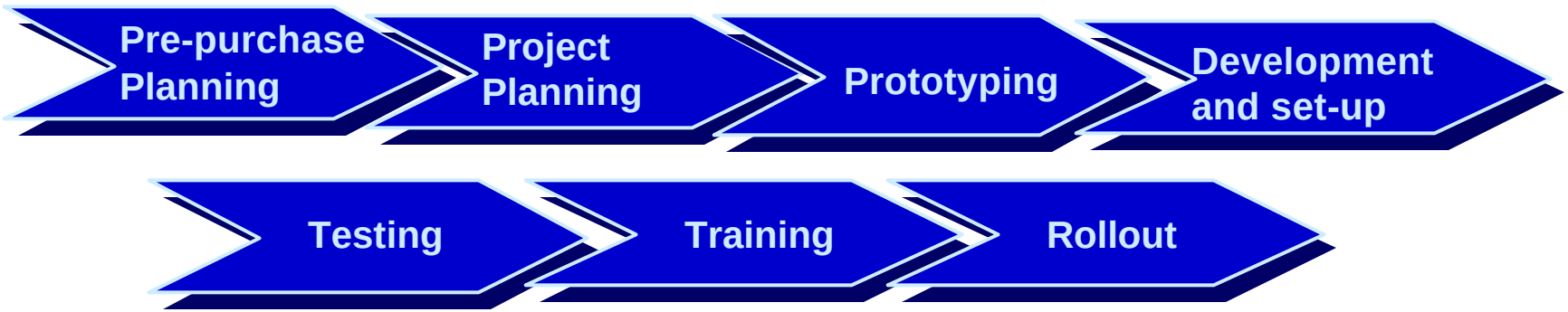

- Pre-purchase Planning
  - Define initial requirements
  - Assess architecture
  - Select vendor
- Project Planning
  - Refine requirements
  - Recruit & train team
  - Develop configuration mgmt plan
  - Establish project infrastructure
- Prototyping
  - Define initial business rules
  - Perform Gap analysis
  - Develop detailed requirements
- Development & Setup
  - Develop interfaces
  - Perform customization
  - Develop data conversion plans
  - Develop reports
- Testing
  - Perform unit, integration & system test
- Training
  - Develop user training material
  - Conduct Instructor & user training
- Rollout

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ERP Implementation

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Big Bang vs. Phased[1]

	Advantages	Disadvantages
Big Bang	• No need for temporary interfaces • Limited need to maintain legacy software • Lower Risks due to concentrated team focus • Easier module linkage • Shorter implementation time. • Lower Cost	• Large peak resources • Resources more spread out • Higher risk of total system failure • Cannot fall back on legacy system • Less opportunities for 'hands-on' knowledge • Greater time from development and 'Go-Live'
Phased	• Lower peak resource requirements • More intensive direction of resources • Lower risks overall vs. 'all or nothing' • Legacy system fallback • Increasing knowledge through each phase • Early working system demonstration	• Heavy use of temporary interfaces • Maintain and revise legacy software • risk of uninvolved/uncoordinated personnel • personnel turnover • longer installation period • higher total cost

[1] Daniel O'Leary – *Enterprise Resource Planning Systems*

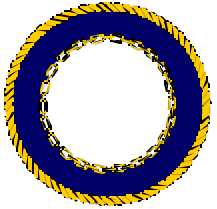
Software Sizing Metrics Definitions

Size the Project

Requirements – a measure of the functionality required

- **SLOC - Source lines of code that measure computer program size**
- **Function Points - measure SW by quantifying the functionality the SW provides to the user or the work products provided by developers**
  - **External inputs, External outputs, external inquiries, internal logical files & external interface files**
- **Objects – based on counting anything (real or abstract) about which we store data and the operations that manipulate the data; things that carry data with behavior attached; objects are counted instead of functionality**
- **Use Cases - measure SW from the perspective of how the user will actually use the system vice the features the system is required to incorporate; UML Notation**

Software Sizing Metrics Variations



- SLOC
  - physical, logical, executable, non-executable, comments, delivered, …
- Function Points
  - feature pts, Symons' Mark II function points, 3-D function points, etc.
- Objects
  - object points, predictive object points OO function points, SEER object points, etc.
- Use Cases
  - use case points

Software Sizing Metrics Pros/Cons

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- SLOC
  - **Widely utilized in real-time systems and many legacy IT systems; applicable during the middle phases of a project**
  - **Wide discrepancies occur even with standard definitions; driven by language choices; does not adequately address COTS-based systems**
- Function Points
  - **Language/technology independent; applicable during the beginning and end of a project**
  - **Doesn't capture non-functional requirements (how SW must perform) or technical and design constraints (how SW will be built); still unproven in regards to lowering size growth**
- Objects
  - **User interface oriented; less subjective, easier calculations**
  - **Not widely utilized, hence validated productivity metrics unavailable; promising metric for ERP implementations**
- Use Cases
  - **Use case pts are based on use case model so it's easier to develop automatic counters;**
  - **Haven't reached the level of standardization of detailed required, hence their may be large differences in how different individuals count use case points; relationship to other sizing metrics still unvalidated**

Software Sizing Metrics

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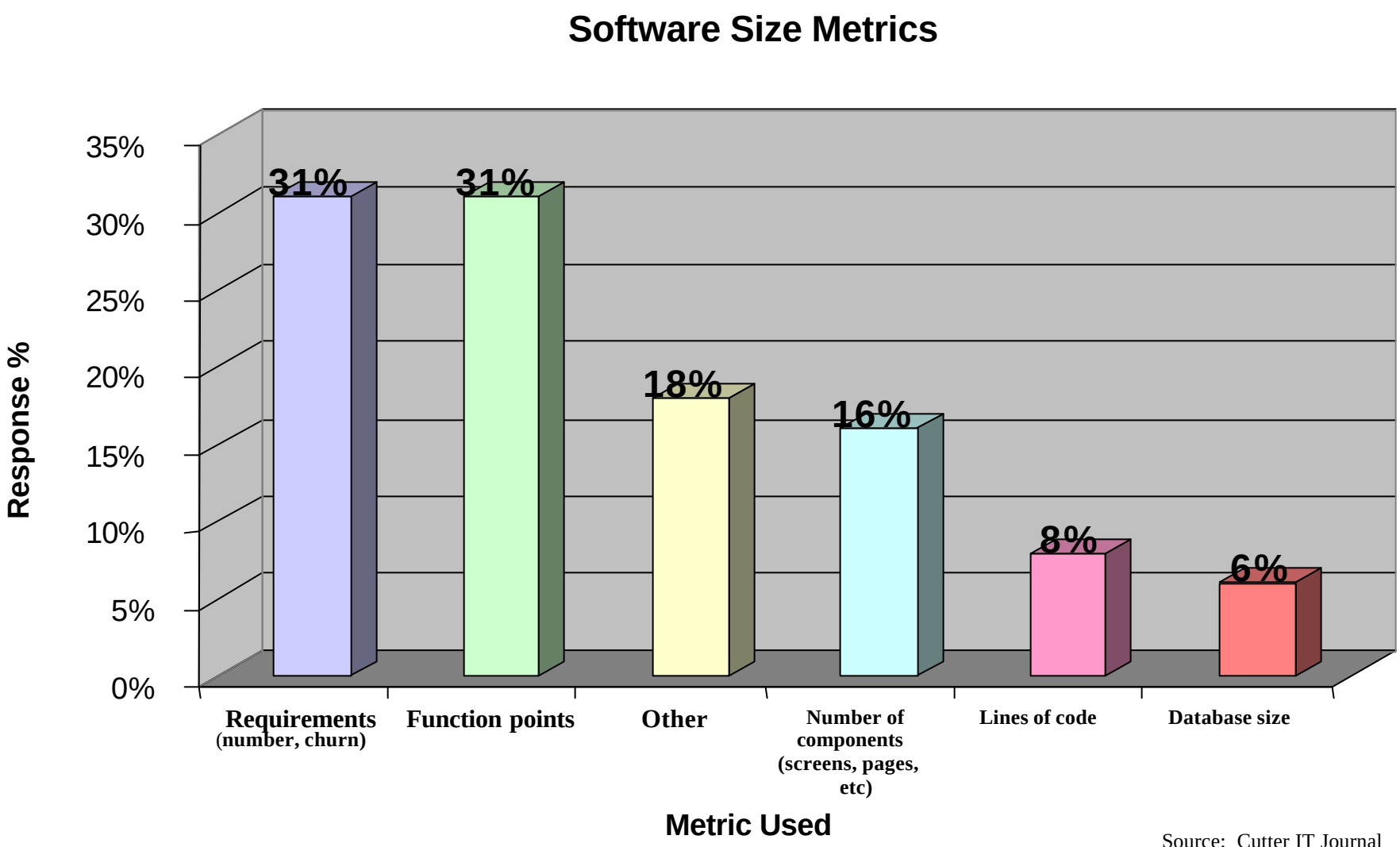

Source: Cutter IT Journal

Software Sizing Metrics Definitions

Size the Project

Requirements – a measure of the functionality required

- **SLOC - Source lines of code that measure computer program size**
- **Function Points - measure SW by quantifying the functionality the SW provides to the user or the work products provided by developers**
  - **External inputs, External outputs, external inquiries, internal logical files & external interface files**
- **Objects – based on counting anything (real or abstract) about which we store data and the operations that manipulate the data; things that carry data with behavior attached; objects are counted instead of functionality**
- **Use Cases - measure SW from the perspective of how the user will actually use the system vice the features the system is required to incorporate; UML Notation**

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Software Sizing Metrics

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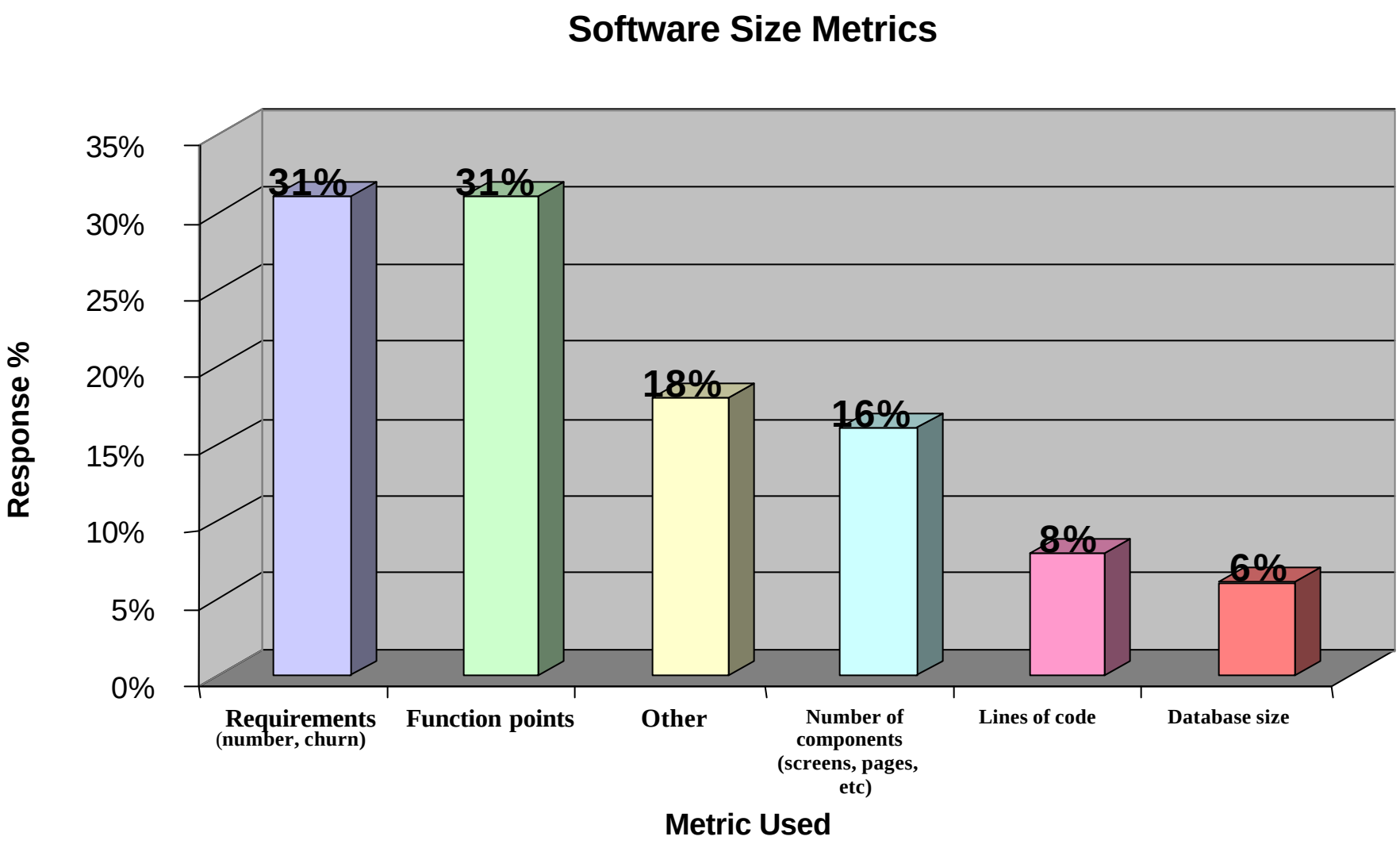

ERP 'Development'

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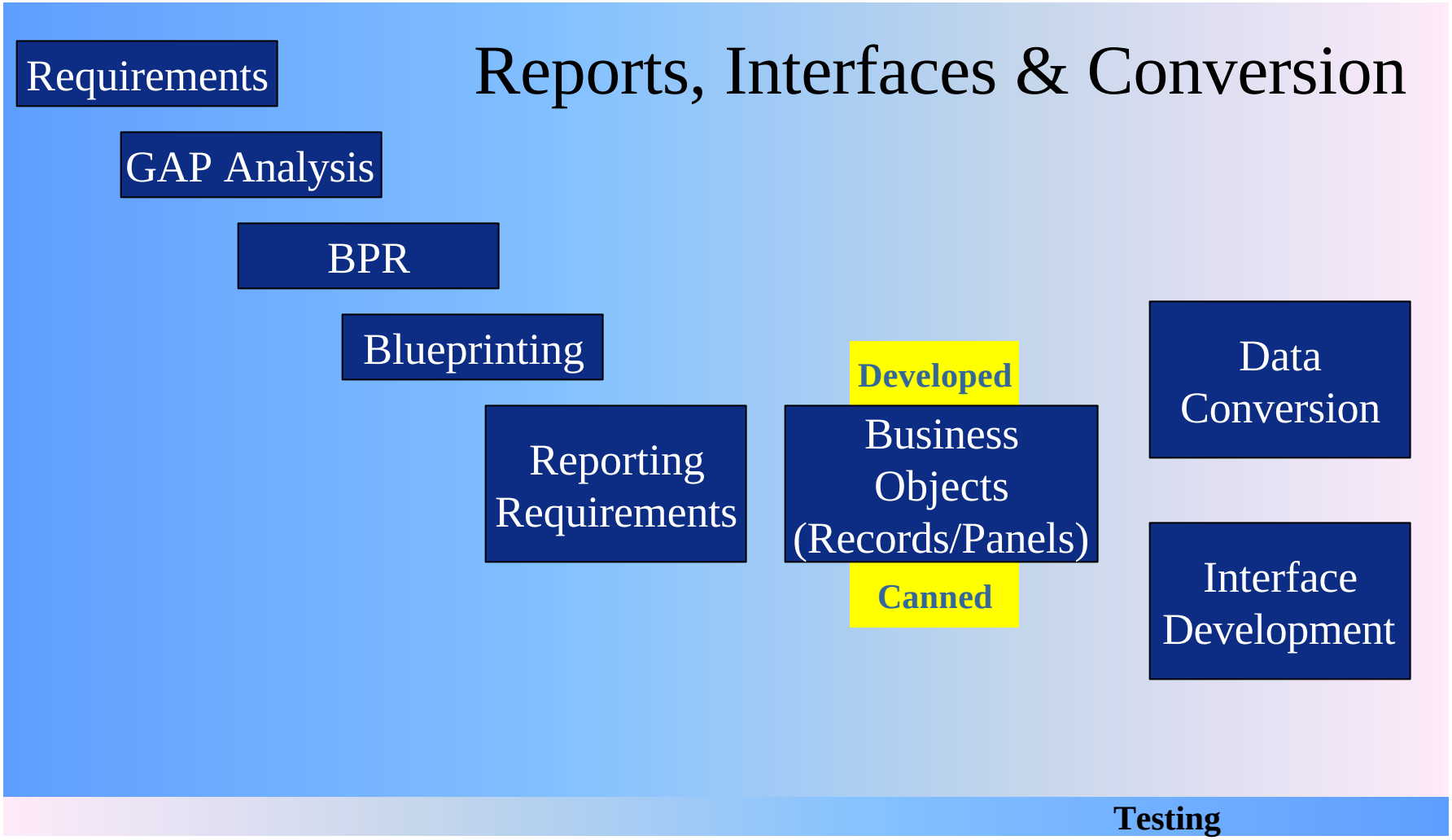

ERP Software Estimation Other Thoughts

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QSM Research:

- **Methodology to implement the chosen package different from traditional projects so estimating models must be adapted**
- **However, QSM DB has shown that ERP packages have the same relationships between cost, effort, schedule, reliability and cost as more traditional developments.**

IMG code (basic functionality provided by COTS product)

+

ABAP Code (for additional functionality required)

*

Complexity

=

ERP Units (based on SAP)

Size of the ERP implementation = 1) amount of initial configuration +
2) customized development to make it fit

Estimating metrics then become comparable to traditional development efforts

[1]Source: Estimating ERP developments by Robert Ward, QSM

ERP Project Management

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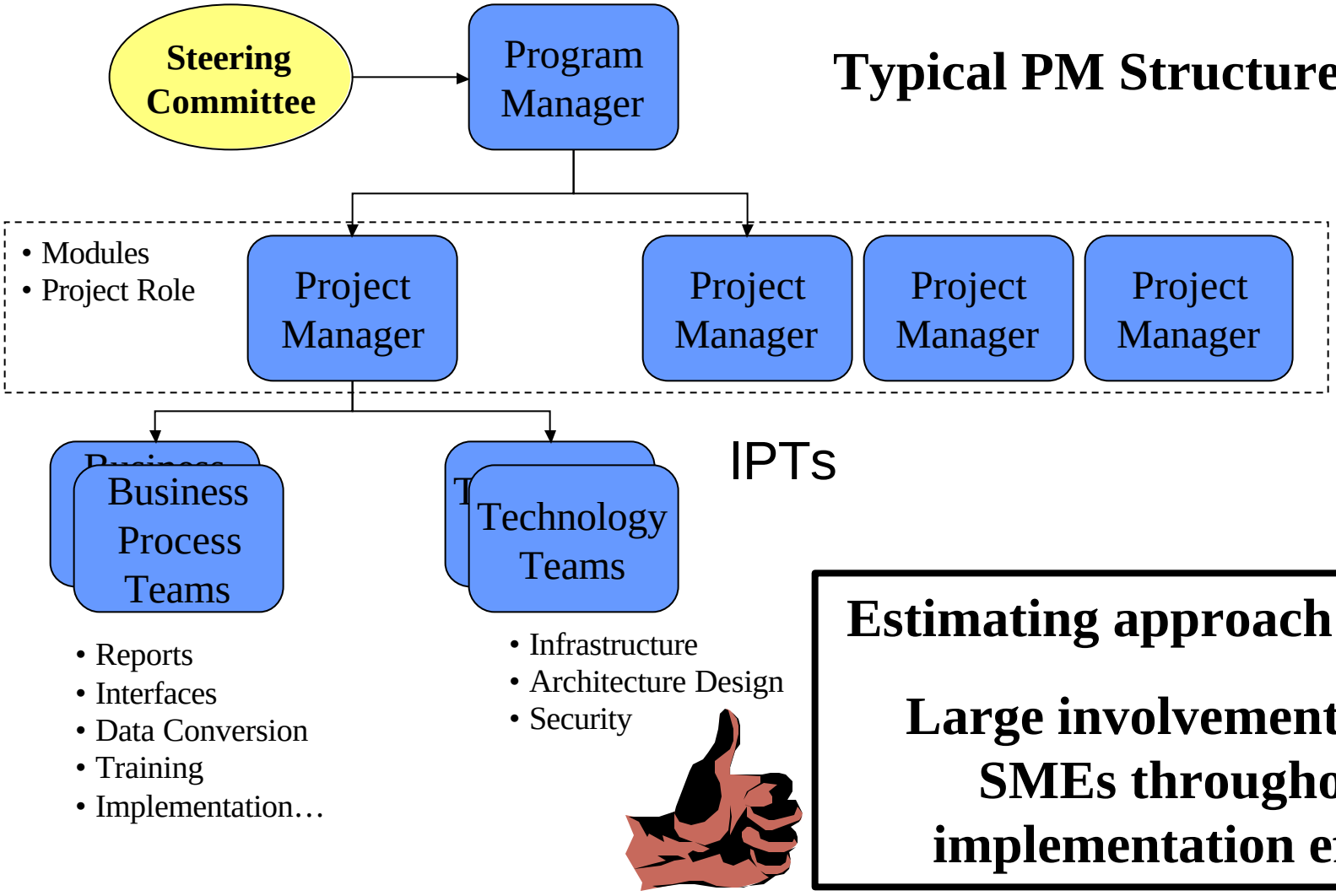
Typical PM Structure



Estimating approach similar;

Large involvement from SMEs throughout implementation effort

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BPR/Gap Analysis

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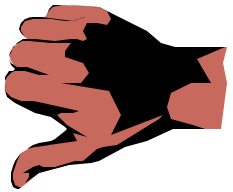
- Used to evaluate the requirements of the 'to be' process and an ERP package.
- Resolution of Gap can range from requiring modification of COTS to changes in requirements to ***changes in business processes.***

Resolution	Number of Gaps
Total Number of Gaps	40
Process/Requirement Changes or Standard ERP Software Functionality Found	20
Bolt-On	4
Interfaces	4
Development Effort	12



True BPR didn't occur previously;

BPR effort and time to obtain waivers is extensive

Data Conversion

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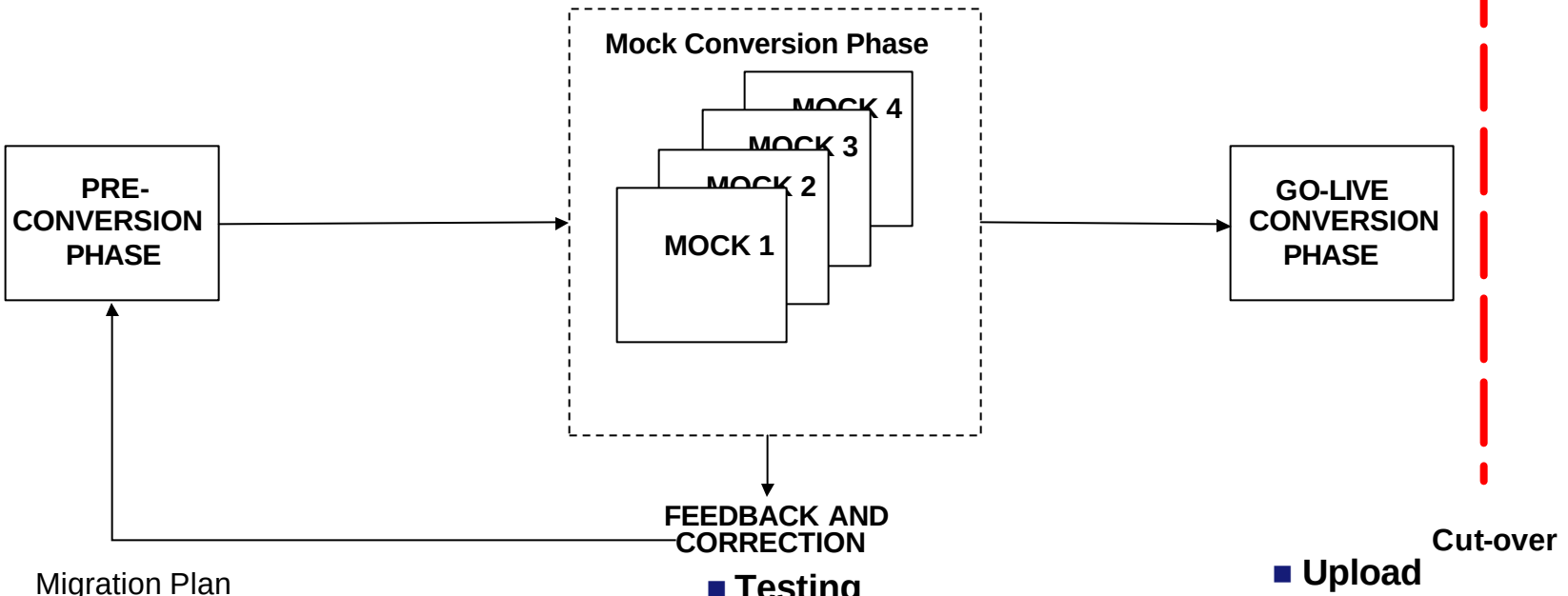

- Migration Plan
- Mapping
- Legacy Data ID
- Extraction
- Cleansing

- **Testing**
- **Upload**

- **Upload**

Approach similar;

Configuration management increases due to new management of new COTS releases.

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Interfaces

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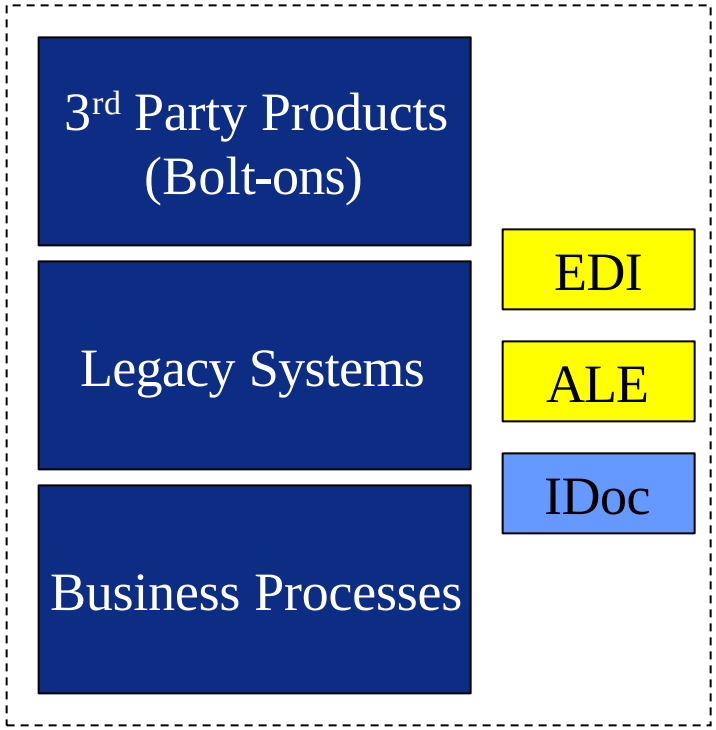
Interfaces facilitate the sharing of information between *Trading Partners* within an organization and across organizations.

Interfaces are:

- **Temporary**
  - **migration of legacy system data (temporary/data transfer)**
- **Permanent**
  - **sharing of information between applications**
  - **sharing of information between organizations (B2B)**
  - **maintained**

Interfaces

Interfaces facilitate the sharing of information within an organization across business processes…



EDI – (*Electronic Data Interchange)*

Provides business process integration by exchanging business documents using Industry standard formats (e.g. ANSIX12).

ALE – *(Application Link & Enabling)*

SAP proprietary technology designed for the integration of distributed business processes. (both SAP and non-SAP)

IDoc – (*Intermediate Document)*

A proprietary SAP interface that defines The format and structure of data that is Exchanged between two systems.

Interface Development

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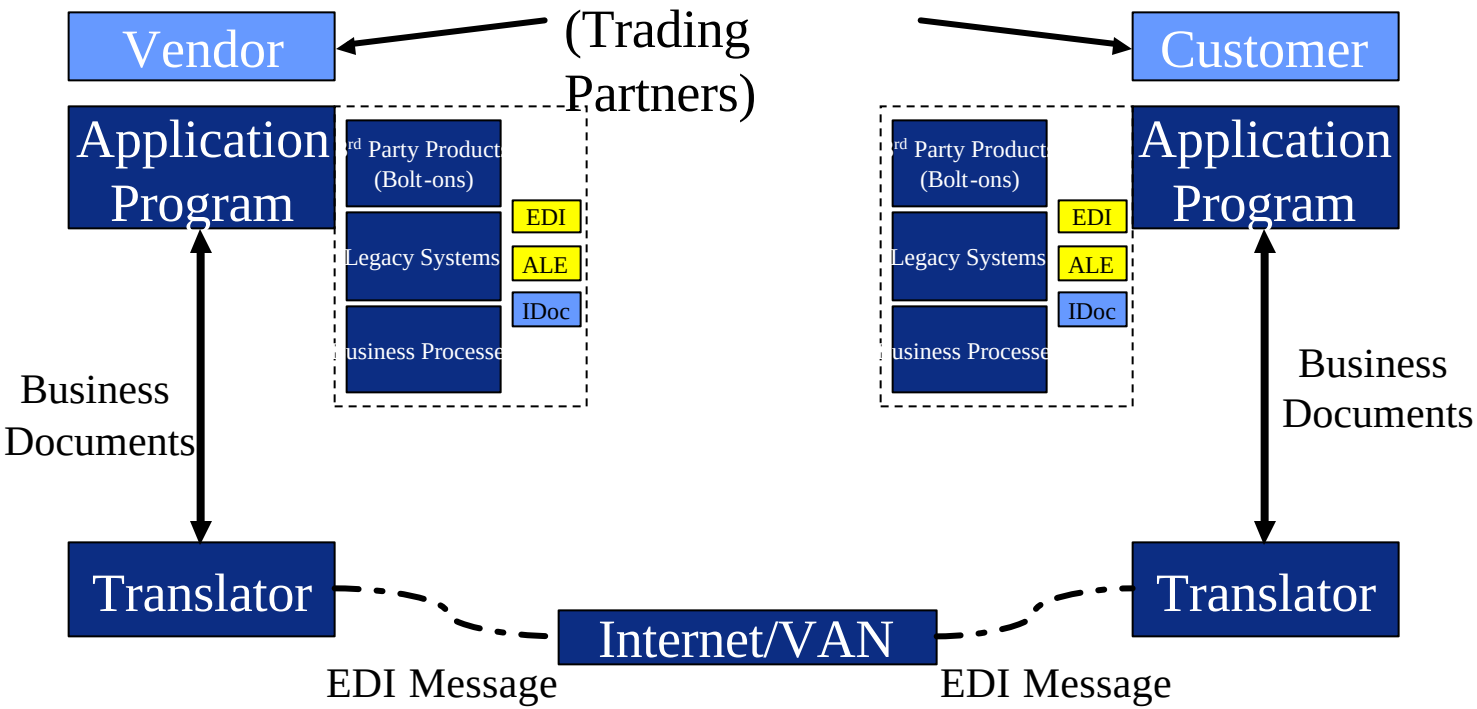

Estimating approach similar;

Quantity and complexity may change

Training

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• A major aspect of ERP is BPR. More often than not, users roles are redefined or modified under the ERP plan, so users require functional training

• In addition to end-user training, developers must be trained on the ERP software and tools used throughout implementation.

•The standard approach to training entails the formation of a training team (IPT), comprised of SMEs from sites within the scope of the ERP implementation.

• The training IPT members develop the training, and then return home to act as trainers.

• The scope of end-user training consists of:
  - ERP software
  - ERP specific overview
  - Functional Core specific (Finance, HR, …)
  - Core Area (Budgeting, Payroll…)
  - Job Specific

Estimating approach similar; BPR has caused scope of training to increase

* Daniel O'Leary – *Enterprise Resource Planning Systems*

Other Research Efforts

- Daneva – Deriving FP from SAP Business Process Modules and objects
- Stewart – Using use cases for sizing OO SW applications
- Longstreet Consulting Inc. – Use Cases and Function points
- Nageswaran – Test Effort Estimation using Use Case points
- Smith – The Estimation of Effort based on Use Cases
- Fetcke, Abran & Nguyen – Mapping the OO-Jacobson Approach into Function Point Analysis
- Anda, Dreiem, Sjoberg and Jorgensen – Estimating SW development Effort based on Use Cases – Experiences from Industry
- Ward – Estimating ERP developments